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HYDRO-ELECTRIC INQUIRY COMMISSION

REPORT
ON
NIAGARA SYSTEM

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NIAGARA SYSTEM

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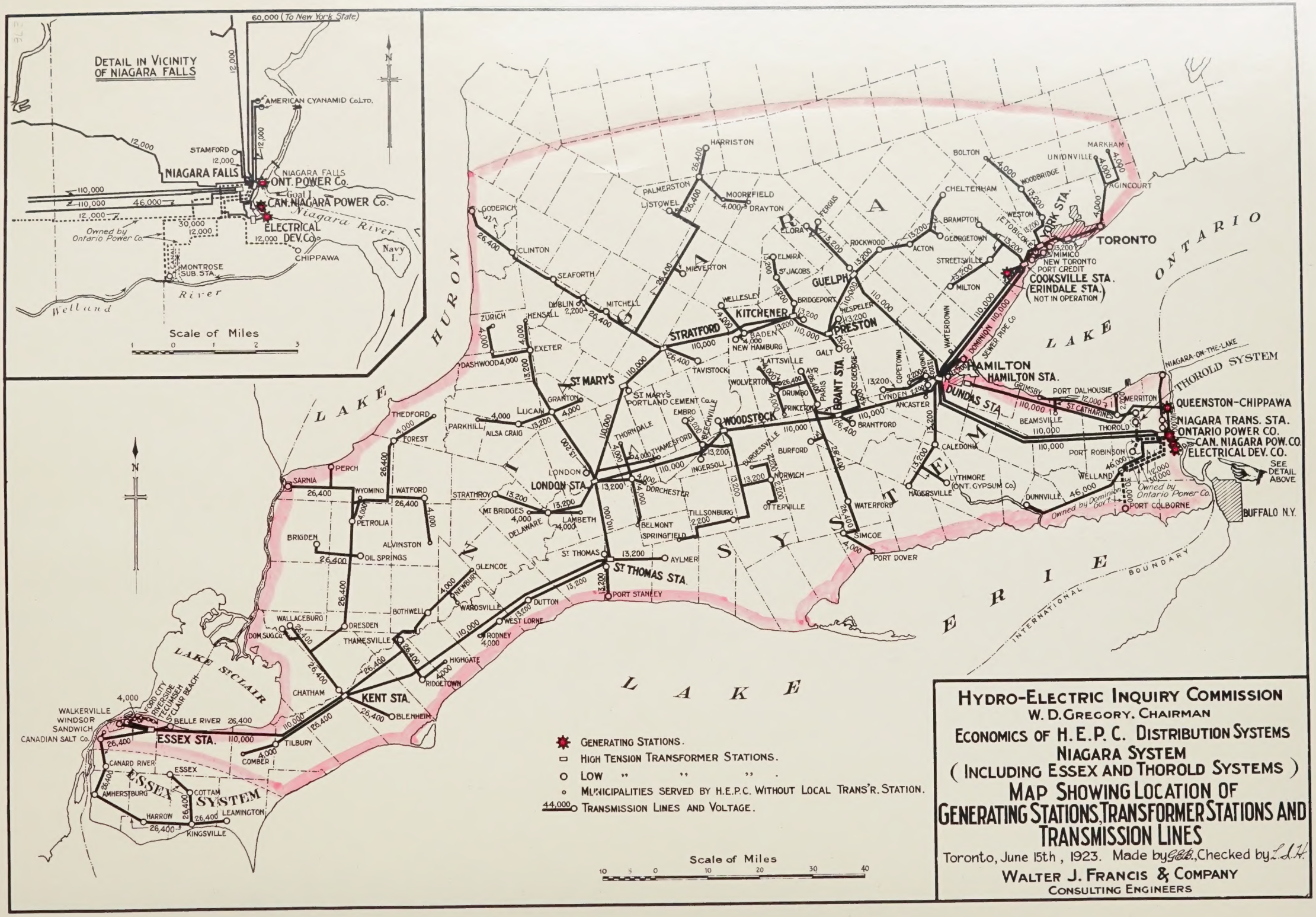
NIAGARA SYSTEM



Hydro-Electric Inquiry Commission

W. D. Gregory, Chairman

Economics of H.E.P.C. Distribution Systems

Niagara System

(Including Essex and Thorold Systems)

Map Showing Location of Generating Stations, Transformer Stations and Transmission Lines

Toronto, June 15th, 1923. Made by G.E.B., Checked by L.J.H.

Walter J. Francis & Company

Consulting Engineers

Map Showing Location of

Niagara System

(outlined in red)

To His Honour Henry Cockshutt,

Lieutenant-Governor of the Province of Ontario.

May it Please Your Honour:

In pursuance of instructions contained in the commission issued to us by Your Honour, we have inquired into and now respectfully report upon the undertaking of the Hydro-Electric Power Commission of Ontario, (hereinafter called "the Commission"), known as the Niagara System. Inasmuch as the construction and acquisition by the Commission of development plants at Niagara Falls within the past six years have involved a capital investment in excess of $100,000,000, special attention has been given to the future operation of the System in combination with these plants. With our report we submit the report of our Consulting Engineer, Mr. Walter J. Francis, on the Engineering Economics of the Niagara System (Part 1 and Part 2) and three reports of our Accountants, Messrs. Price, Waterhouse & Company.

HISTORICAL SKETCH

The Hydro-Electric Power Commission of Ontario was created by the Legislature of Ontario in 1906. Power was given to it to enter into contracts with municipal and other

corporations for the transmission and supply of electrical power. Since this date the powers of the Commission have been extended and amended, and its operations have grown to vast proportions. In 1906 by-laws were passed in a number of cities, towns and villages, authorising the Councils of these municipalities to enter into contracts with the Commission for a supply of electrical power to be transmitted from Niagara Falls.

By "The Power Commission Act", passed by the Legislature in 1907, the Commission, acting for the municipalities receiving power, was authorised to construct generating plants, transformer stations, transmission lines and distributing stations for the purpose of generating, transmitting and distributing power to municipalities in Ontario.

On March 29th, 1909, "The Power Commission Amendment Act, 1909" was passed amending the Act of 1907 before referred to, and validating the agreements dated May 4th, 1908, between the Commission and the municipal corporations of Toronto, London, Guelph, Stratford, St. Thomas, Woodstock, Kitchener, Galt, Hespeler, St. Mary's, Preston, Waterloo, New Hamburg and Ingersoll, by which the Commission agreed, among other things, to construct lines to transmit electrical energy from Niagara Falls to the several municipal corporations, and to have this electrical energy available in the municipalities on the 19th day of March, 1910, in such quantities as the municipalities had requested.

In 1906, when the Commission invited the hydro-electric power companies at Niagara Falls to submit a price on 100,000 electrical horse-power to be delivered to the Commission, the lowest tender was received from The Ontario Power Company of Niagara Falls. A contract was thereupon entered into between the Commission and the company on March 19th, 1908, for a maximum of 100,000 horse-power to be taken in certain blocks as required. This contract fixed the rate for 12,000-volt power at $9.40 per horse-power per annum up to 25,000 horse-power, and at $9.00 per horse-power per annum for all the power when the amount reserved and held ready for delivery upon the order of the Commission totalled 25,000 horse-power or more. An additional charge of $1.00 per horse-power per annum for power delivered at 60,000 volts was agreed upon. The duration of the contract corresponded with the water lease of the company from the Queen Victoria Niagara Falls Park Commission, which was granted for a term of 50 years, commencing April 1st, 1900, with three optional renewal periods of 20 years each, making the total period under the option 110 years extending to April 1st, 2010.

Power was first delivered to the Niagara System's step-up station from The Ontario Power Company on August 25th, 1910, and on October 11th, 1910, power was officially delivered to Berlin, (now Kitchener), over the 110,000-volt lines between Niagara Falls and Berlin by way of Dundas,

Guelph and Preston. During the month of November power was supplied to the municipalities of Guelph, Woodstock, Preston and Waterloo. London, Stratford and Hamilton were connected to the system in December, and on February 24th, 1911, power was first delivered to the Toronto substation. By October 1911, twenty municipalities and two industrial corporations were supplied by the system, and about 12,000 horse-power was being delivered to the Commission by The Ontario Power Company; in 1912, the power delivered was about 30,000 horse-power; in 1914, 68,000 horse-power; in 1915, 94,000 horse-power was taken by 85 municipalities and on March 25th, 1916, the amount of power, ordered to be held in reserve by The Ontario Power Company for the Commission for the supply of the Niagara System, reached the total of the 100,000 horse-power available under the contract of March 19th, 1908.

When it was evident that the full amount of 100,000 horse-power available from The Ontario Power Company would be entirely absorbed by the Niagara System, it became necessary to provide for additional power. The Commission, having decided to ask for authority to develop its own power on a large scale, laid a proposal to that end before the Provincial Government in 1913. Powers enabling the Commission to proceed with the project as outlined were obtained in 1914,

but it was not until 1917, under "The Ontario Niagara Development Act, 1917", (7 George V. Chap.21) that final authority was given and work was commenced on what is known as the Queenston-Chippawa Power Development.

In the meantime, the demand for power had grown so rapidly that in 1915 it was necessary to purchase a temporary supply of 16,000 horse-power from the Toronto Power Company; in 1916, 50,000 horse-power additional was obtained from the Canadian Niagara Power Company, and this 50,000 was all sold by January, 1917.

On August 1st, 1917, the Commission purchased the capital stock of The Ontario Power Company of Niagara Falls, and shortly afterwards made plans to increase its capacity by the construction of a third pipe line and the installation of two new units of 12,000 kilowatts each. The extension was completed in 1919, and the capacity of The Ontario Power Company was increased by about 40,000 horse-power to a total of approximately 200,000 horse-power.

The amount obtainable under contract with the Canadian Niagara Power Company was increased to 59,000 horse-power in 1919, and in 1920 the Commission, in conjunction with the City of Toronto, began negotiations for the purchase of the Toronto Power Company. By the end of 1921 the Commission was purchasing additional power at Niagara Falls under day-to-day contracts to the extent of 90,000 horse-power.

Operation of the new Queenston-Chippawa plant commenced in December 1921, with No.1 generator of 45,000 kv-a. capacity. Four other generators of like capacity are now in operation, No.2 having started in March 1922; No.3 in October 1922; No.4 in November 1922; and No.5 in April 1923, completing the initial development of about 300,000 horse-power. Generator No.6 is under construction, and we are informed that the Commission expects to have it running in the spring of 1924. Generators Nos.7 and 8 have been ordered in anticipation of being in service late next year.

On April 30th, 1922, an accident occurred in the plant of The Ontario Power Company which completely destroyed the two new units, Nos. 15 and 16, and reduced the capacity of the plant to about 175,000 horse-power until one or both units will have been replaced. A number of other machines were damaged by water and the temporary reduction in capacity was much greater than 25,000 horse-power.

In the broadest sense the Niagara System at the present time may be said to embrace:

(a) The complete Queenston-Chippawa Power Development with a peak capacity now installed of about 300,000 horse-power, and which during the years 1923-1924 will probably be increased to about 550,000 horse-power.

(b) The generating plant, transformer stations, transmission lines, property and so forth, which are controlled

by the Commission through its ownership of the entire capital stock of The Ontario Power Company of Niagara Falls and its subsidiary The Ontario Transmission Company, Limited. The capacity of this plant is about 175,000 horse-power, and is being increased to about 190,000 horse-power by the reconstitution of one of the generating units destroyed in the accident of April 20th, 1922.

(c) The generating plant, transformer stations, transmission lines, property, etc., which are controlled by the Commission through the purchase of the Toronto Power Company. The capacity of this plant is about 125,000 horse-power.

(d) The right-of-way, transformer stations, transmission lines, distributing stations, and so forth, constructed for the purpose of transmitting and distributing power to the various municipalities and companies on the system, and

(e) The Niagara Rural Lines, which consist of primary or main lines constructed by the Commission to supply electrical power to customers adjacent to certain municipalities.

The Niagara System proper, however, consists only of items (d) and (e) and, therefore, does not include any generating stations, except the very small Erindale plant on the Credit River. At October 31st, 1921, it included 466.9 miles of 110,000-volt steel tower lines, and 1007.38 miles of lines of 46,000 volts or lower voltages constructed

by the Immaculate Energy its generosity in furnishing
capital stock of the Pacific Power Company of Niagara Falls
and the subsidiary the Oswego Transmission Company, Limited.
The capacity of this plant is about 175,000 horse-power, and
is today increased to about 190,000 horse-power by the con-
construction of one of the generating units described in
the analysis of April 20th, 1922.

(4) The generating plant, transformer stations, trans-
mission lines, switches, etc., which are controlled by the
Niagara Falls Power Company of the Ontario Power Company,
the capacity of which is about 115,000 horse-power.

(5) The right-of-way, transmission facilities, trans-
mission lines, transformer stations, and so on, constructed
for the purpose of transmitting and distributing power in the
various municipalities and districts in the province, and

(6) The Niagara Falls Power, which consists of primary
or main line conductors in the connection to supply elec-
tric power to approximately 20 electric municipalities.

The Niagara Falls Power, however, consists only of
items (1) and (2) and, therefore, does not include the
generating stations, nor the very small generating power
on the Niagara River. In October 1923, it increased
its active of 110,000-volt steel tower line, and 187,500
active at times of 88,000 volts on large transmission

on steel and on wooden supports; the main transformer station at Niagara and fifteen step-down transformer stations supplying sixty-five distributing stations with a total capacity of about 600,000 kv-a. including reserves. The system in 1921 was supplying 158,149 horse-power to one hundred and twenty-two municipalities, and 45,371 horse-power to twenty-four private companies and others, and to the Essex and Thorold Systems. In 1922, these figures had grown to 190,625 horse-power and 51,912 horse-power, respectively.

PHYSICAL

General

The Niagara System lies immediately north of Lake Erie and extends from Lake Ontario to Lake Huron. The maximum extent east and west is about 225 miles from Toronto and Niagara Falls on the east to Sarnia, Chatham and Windsor on the west. At the extreme western tip of the Niagara System is the Essex System, which is supplied with power from the Essex transformer station of the Niagara System. On the north the Niagara System is bounded by the territory included in the "Combined Northern Systems", namely the Eugenia, Severn and Wasdell's Systems.

on Ethel and on other occasions. The main transformer station at Glenora and fifteen step-down transformer stations line alongside-line distributing stations with a total capacity of about 400,000 kw., including reserves. The system is fully two duplicated 220,000 volt-point to one another and transfer-reliability, and 80,000 horse-power to twenty-four outside municipalities and IRVIN, and to the Town and Township systems. In 1921, these figures had grown to 320,000 horse-power and 81,000 horse-power, respectively.

[illegible]

Summary

The Niagara System has an installed capacity of [illegible] and actual [illegible] MARKET AS LOAD FACTOR. The maximum output was and was in about 400 miles from Toronto and Niagara Falls on the east to [illegible]. Consumers are spread on the west. In the extreme western tip of the Niagara System is the Detroit system, which is serving this [illegible] Detroit transformer station of the Niagara System. On the south the Niagara System is bounded by the territory included in the "Hydro Electric System", namely the "Hydro", Bowen and Lambton's systems.

Speaking generally, the Niagara System consists of a step-up transformer station receiving power from a number of generating stations at Niagara Falls, including the Queenston-Chippawa Power Development, a network of 110,000-volt and lower voltage transmission lines, which were furnishing power, at October 31st, 1921, to fifteen step-down transformer stations supplying one hundred and twenty-two municipalities, to the London Railway Commission, to twenty-four companies and other private consumers, and to the Essex and Thorold Systems.

Generating Stations and
Other Sources of Power Supply

The Niagara System in its broadest sense includes three large and one small hydro-electric generating stations: The Ontario Power Company of Niagara Falls, with a present capacity of about 175,000 horse-power, which is now being reconstituted to about 190,000 horse-power; the Toronto Power Company, also known as the Electrical Development Company, with a capacity of about 125,000 horse-power; the Queenston-Chippawa Power Development, with a present installed peak capacity of about 300,000 horse-power; and the Erindale plant on the Credit River. It also has available some purchased power from the Canadian Niagara Power Company at Niagara Falls.

(a) The Ontario Power Company of Niagara Falls

A description of the plant of the company may be found in our special report on "The Ontario Power Company of Niagara Falls".

(b) The Toronto Power Company

The Electrical Development Company station referred to as part of the Toronto Power Company was built by the Electrical Development Company, the first four 14,000 horse-power units being installed in 1906 and 1907 and seven 15,500 horse-power units added between 1910 and 1914. The plant was operated under lease to the Toronto Power Company, Limited, from April 1909, until its acquisition by the Commission under the terms of the agreement signed August 15th, 1922.

This hydro-electric plant includes a concrete wing dam at the head of the falls, 955 feet long and 27 feet high. The water is led through 10-feet steel penstocks to a wheel-pit 416 feet long, 22 feet wide and 150 feet deep. The tail water is discharged through twin tunnels, 28 feet in diameter, converging below the power house into a single tunnel 1,935 feet long with an outlet at the foot of the Horseshoe Falls. The power house, built of Indiana limestone, is of ornate and imposing design, and is 500 feet long and 70 feet wide. The plant installed is as follows: Turbines - four I.P.Morris 69-inch vertical double-runner, 250 r.p.m., 14,000 h.p. each; seven I.P.Morris, 75 3/4-inch, vertical, double-runner, 250 r.p.m., 15,500 h.p. each; total 164,500 h.p.; Generators - four Canadian General Electric, 3-phase, 25-cycle, 12,000-volt, 250 r.p.m., 8,000 kv-a. each; seven Canadian General Electric, 3-phase, 25 cycle, 12,000-volt, 250 r.p.m., 10,000 kv-a. each;

total 102,000 kv-a.; Exciter Turbines - two I.P.Morris, 27 3/4-inch, vertical, 500 r.p.m., 500 h.p. each, total 1,000 h.p.; Exciter Generators - four Canadian General Electric, D.C., 125-volt, 500 r.p.m., 300 kw. each (two being driven by the exciter turbines and two being motor-driven); and eleven direct-connected exciters, one on each of the main units; Station Transformers - three banks of three Canadian General Electric, single-phase, 2670 kv-a. each, 12,000 to 60,000 volts; three banks of two Canadian General Electric single-phase, 6,000 kv-a. each, 12,000 to 60,000 volts; total 50,000 kv-a.

It is stated by the engineers of the Commission that the Electrical Development Company plant operates under an average head of about 130 feet, and that it operates continuously at a load factor of almost 100 per cent. The auxiliary steam power station located in Toronto was originally installed by the Toronto Electric Light Company in 1883, but the present units were installed as follows: two 2,700 h.p. units in 1912, one 10,000 h.p. unit in 1913, and one 8,700 h.p. unit in 1916.

It is variously estimated that an amount between 12,500 and 13,300 cubic feet of water per second is required to produce approximately 146,000 horse-power, the larger figure giving about 11 horse-power per cubic foot per second. The best efficiency of the plant is stated by the engineers to be

obtained at an output between 100,000 and 120,000 horse-power. According to the agreement with the Queen Victoria Niagara Falls Park Commissioners, the amount of water permitted to be diverted by the Electrical Development Company is that required to produce 125,000 horse-power.

(c) The Queenston-Chippawa Power Development

The Queenston-Chippawa Power Development, the power house of which is situated near Queenston, is the first on the Niagara River to utilize the full head available between the level of Lake Erie and that of Lake Ontario. The water is diverted from the mouth of the Welland River at an elevation of approximately 562.5 feet above sea level, while the tail waters are discharged at an elevation of 245.5, an average difference in elevation of 317 feet. The average effective net head at full capacity is estimated to be 305 feet. The generating units are designed to give maximum output at as low as 294 feet head.

The power plant is located about one mile up-stream from Queenston. The water is brought from the Lake Erie level to the power house by means of the Welland River for about four miles, and by a canal between the river and the forebay located adjacent to the power house but on the upper level.

The intake for the development is at the mouth of the Welland River and the engineers of the Commission have provided for admission of water by submerged tubes should ice troubles materialize during the early years of operation. Meanwhile

the intake will be operated in the usual way as a submerged boom structure.

The canal between the Niagara River and the entrance to the forebay is 66,287 feet in length. The capacity of the intake and canal was designed to insure a working flow of at least 15,000 cubic feet per second, but the engineers of the Commission and their advisory engineers predict that the flow will exceed this amount, some calculating it at over 18,000 cubic feet per second. A discussion of this point in detail will follow in a report by our Consulting Engineer, Mr. Francis.

The screen house is placed 75 feet back from the edge of the Gorge and provision is made in the design for either nine or ten main inlets for the penstocks to the main turbines and for two inlets for penstocks for service turbines. Each main inlet is divided into three sections by piers and in each section there is a screen, upstream from which slots for stop-logs are provided.

The upper two-thirds of each main penstock is 16 feet in diameter and the lower third is 14 feet. The distance from the inlet screens to the centre line of the turbines is about 460 feet. The penstocks are covered with eighteen inches of concrete and at the lower end of each a Johnson valve is installed.

The generating station is at present completed for five vertical-shaft units nominally of 55,000 horse-power each. It is later proposed to install either four or five additional

units of similar capacity, making the ultimate installed plant capacity about 550,000. The present turbines are designed to operate at 187.5 revolutions per minute under a head of 305 feet, and they have a guaranteed efficiency of 88 per cent.

Each turbine is direct-connected to a 45,000 kv-a., 12,000-volt, 3-phase, 25-cycle generator. Current limiting reactors are provided between generators on the 12,000-volt bus. The generators show very high efficiencies, and the overall efficiency of the generators, turbines and switchgear from the water to the 12,000-volt bus bars is apparently over 90 per cent. Transformers step up the voltage to 110,000 volts to supply power to the Niagara System.

With a net head of 305 feet between the forebay and the lower river, the output per cubic foot of water per second at 90 per cent. efficiency is approximately 31 horse-power delivered to the low voltage bus bars.

The expenditures of the Commission in respect of the Queenston-Chippawa Development amounted to about $53,000,000 at October 31st, 1921, and about $65,600,000 at October 31st, 1922. The total capital cost with about 550,000 horse-power nominal installed capacity when completed will probably be of the order of $82,400,000, which will represent the Provincial liability in connection with this undertaking.

(d) The Brindale Plant

The Brindale hydro-electric plant, situated on the Credit River, was installed in 1910 with a capacity of about 1,600 horse-power. The plant formerly operated under an average head of 56 feet, but this head has been reduced owing to unrepaired damages to the dam structure. Auxiliary power was obtained from the combined steam and hydraulic plant of the Interurban Electric Company, near Lambton, Ontario.

The development consists of an earth dam with a concrete core, 700 feet long and 35 feet high, from which a 900-foot tunnel leads to a storage tank immediately adjoining the concrete power house. Two 850 horse-power turbines are direct-connected to two 600-kilowatt, 3-phase, 60-cycle, 13,200-volt generators. The plant is operated from one to five hours daily during peak loads, and is connected to the Niagara System through a frequency-changer set, the generator of which may be used as a synchronous condenser when required. The Brindale generating station was purchased by the Commission in 1917, and on December 14th of that year its output was first delivered to the Niagara System.

(e) The Canadian Niagara Power Company

The plant of the Canadian Niagara Power Company, from which a large block of power has been and is being purchased for the Niagara System, is situated above the Horseshoe Falls, the head-

(d) The Tsumaria Plant

The Tsumaria steam-turbine plant, situated on the Tsumaria River, was installed in 1910 with a capacity of about 1,400 kilowatts. The plant thereafter supplied power to the Tsumaria Sugar Mill at Ko Sawa, but this mill has been closed since the temporary damages to the dam structure. Usually power was obtained from the combined steam and hydraulic plant of the International Industrial Company, Ltd., Limited, Tsumaria.

The development consists of an earth dam with a concrete core. The rock inlet and 36-inch pipe, from which a steel lined tube 24 [illegible] inches in diameter, [illegible] the hydraulic power station. The plant is operated from one to five hours daily during peak loads, and is connected to the Tsumaria system through a transformer-station [illegible] and an 11,000-volt line of about [illegible] miles in length. The original station was purchased by the Commission in 1923, and an [illegible] plant of about [illegible] was first installed in the Kingdom [illegible].

(e) The Kanaiya Hydro-Electric Station

The plant at the Kanaiya Hydro-Electric Station, from which a large [illegible] of power has been and is being [illegible] for the Kingdom Jaffna, is situated [illegible] the [illegible] Valley, the head-

works being adjacent to the power house. Water is drawn from the Niagara River at a point 500 feet above the crest of the Horseshoe Falls through an excavated intake canal 406 feet wide and 200 feet long, protected at the entrance by a system of ice shields, and leading to the stone power house which is 72 feet wide by 580 feet long. The turbines are installed in a deep pit and operate under an average head of 128 feet. The water is admitted from the forebay through short penstocks and is discharged from the wheels through a long, underground, brick-lined tunnel of oblate section, 18 feet by 25 feet in section, with its outlet at the foot of the Falls, just above the generating station of The Ontario Power Company of Niagara Falls. Long vertical shafts connect the turbines with the generators, which are installed in the power house at the ground level 122 feet above the turbines. There are ten main units, five of 10,250 horse-power, three of 10,750 horse-power and two of 12,500 horse-power, a nominal total of 109,000 horse-power. It is understood that an eleventh unit is now being installed as a spare. All generators are three-phase, 25-cycle, 12,000-volt units, and have a combined capacity of 89,500 kilowatts. Nearly all of the energy of the plant is sold in bulk at 12,000 volts or at 22,000 volts, the output being divided as follows: Hydro-Electric Power Commission of Ontario, 50,000 horse-power from 1916 to 1922, inclusive, and 20,000 horse-power thereafter; Niagara Falls Power Company,

works being adjacent to the power house. Water is drawn from the Kingsville River at a point 300 feet above the power house at the Marshall Falls Hydro-Electric Station (about 1½ feet wide and 3½ feet long, protected at the entrance by a grating of the screens, and leading to the power house which is 75 feet wide by 25 feet long). The building and installed is a steel yet upright water or system head of 125 feet. The water is admitted from the leading through short penstocks and is discharged from the wheels through a long, rectangular, reinforced tunnel of ample capacity, 10 feet by 25 feet in reality, with its center at the foot of the falls. Just [illegible] the tailrace of the Marshall Falls Company of Niagara Falls. The original equipment consists of the turbines with the generators, which are installed in the power house at the ground level (it has very low overhead). There are two main units, this at 15,000 horse-power, being at 33,750 horse-power and two of 10,000 horse-power, a nominal total of 187,500 horse-power. It is considered that Marshall Falls is now being incorporated as a whole. All generators are three phase, 50-cycle, 13,800-volt units, and have a combined capacity of 80,000 kilowatts. Nearly all of the energy of the plant is sold in bulk at 14,000 volts to at 33,000 volts, the latter being divided as follows: Hydro-electric power commission of Ontario, 20,000 horse-power (one-third of total), Niagara, 13,000 horse-power (Niagara Falls Power Company).

30,000 horse-power to 40,000 horse-power; the Buffalo General Electric Company is supplied through the Niagara Falls Power Company, while the other consumers include the Norton Company, the Canadian Alexite Company and the Graphite Company, those consumers using the energy for electro-chemical purposes. The plant was constructed in 1904 and additional units were installed in 1913 and 1916.

Between 8,225 and 9,600 cubic feet of water per second is required to develop 100,000 horse-power in the station, the larger figure giving approximately 10.5 horse-power per cubic foot per second.

(f) The International Railway Company

The plant of the International Railway Company also derives its energy from Niagara Falls. It includes an 8-foot penstock leading to a stone power house where a head of only 65 feet is available. Two turbines of 1,000 horse-power each are belted to five 200-kilowatt, 600-volt direct-current generators, and one turbine of 2,000 horse-power is direct-connected to a 1,500-kilowatt, 600-volt, direct-current generator, making a total capacity of 2,500 kilowatts. The power is used by the company for electric railway purposes, with an annual load factor of about 29 per cent. This plant was installed in 1893 and was extended about 1899. The peak load in 1921 was said to be 1,200 kilowatts, requiring probably 300 to 400 cubic feet of water per second.

NOTE: The plant of the International Railway Company is not controlled by the Commission, and has no connection with the Niagara System, but a description of it is given for the purpose of making a complete record of the generating stations in the vicinity of the Falls.

Parallel Operation of the Niagara System with Other Systems

All the stations supplying the Niagara System generate power at 25 cycles while the other systems of the Commission are supplied at 60 cycles. When the loads on the adjacent systems increase beyond the capacity of the local generating stations power must be supplied to them from outside sources, and it seems likely that the available excess capacity of the Niagara System will be used to supply the needs of the Eugenia, Severn and Wasdell's Systems; but frequency-changers will be required to transform from 25-cycle to 60-cycle power. The Essex System is now supplied at 25-cycles from the Essex transformer station of the Niagara System.

There has been some discussion also regarding the supply of Niagara power to Central and Eastern Ontario, for example to the Central Ontario (Trent) Section of the Central Ontario System near Oshawa.

Undeveloped Power Sites

The output of power at Niagara cannot be materially increased unless a greater diversion of water from the Niagara

NOTE: The plant of the Administration Building Shown is not mentioned by the Portuguese, and has no connection with the Kimpese system, but a description of it is given due to the difficulty of getting a description of the generating stations in the mining district.

Partial Description of the Kimpese System with Other Systems

In the operation supplying the Elisabethville district at 22 kv. with other systems of the Katanga Mining Company. Then the loads on the Kimpese system increase, there is an equality of the local generating power that is supplied to them from outside sources, and it seems likely that the available source capacity of the Kimpese system will be equal to the local load of the Katanga Mining Company. The Kimpese system is now supplied at 22-kv. from the Katanga transformer station at the Kimpese Plant.

There has been some discussion that supplying the mining district power to Matadi and Leopoldville, the capacity of the Central Katanga Power Station at the Lubumbashi system was chosen.

Interchanged Power Lines

The supply of power at Kimpese can more be economically interchanged between a greater diversion of water from the Kimpese

River and the Welland River is permitted, or unless the plants were re-located on sites comparable in a hydraulic sense with that of the Queenston-Chippawa plant. The latter course is impracticable at present, and the former would necessitate a revision of international treaty agreements. The Ontario Power Company is stated to be able to develop about 15 horse-power per cubic foot of water per second; The Toronto Power Company about 10 horse-power per cubic foot per second; and the Canadian Niagara Power Company about 10.5 horse-power per cubic foot per second. If no additional diversion of water is allowed by international agreement, it would seem to be advisable to use the available water so far as economically feasible under the maximum head.

The present total diversion on the Canadian side is capable of developing considerably over 1,000,000 horse-power, if used at the full head with an output of about 30 horse-power per cubic foot per second, as is said to be obtained in the Queenston plant. Under existing conditions, without diverting any of the water from The Ontario Power Company or the Toronto Power Company, not more than half of the above amount can be generated.

Miscellaneous Power Plants in the District

There are a large number of power plants within the boundaries of the Niagara System. Some have been idle since

Never was the Niagara River in prohibition, or unless the plants were co-ordinated so that production in a particular stream with that of the transformation plant. The latter danger is impossible of attempt, but the former might conceivably a situation of international trouble occasioned. The Ontario Power Company in stating is so sure it already which it proposes giving the public just at which just moment. The Canada Power Company about 12 [illegible] the [illegible] and the Canadian Niagara Power Company about 12,000 horse-power which just now exists. If no additional diversion of water is allowed by international agreement, it would seem to be advisable to use the [illegible] in the as economically possible under the minimum head.

The present total diversion on the Canadian side is capable of developing approximately over 1,400,000 horse-power. It seems at this time that when no [illegible] of power in excess of that which the Niagara Power Co. may make that year expired, it is safe to be obtained in the Canadian plant. Under existing conditions, without diverting any of the water from the Niagara River changing or the Niagara Power Company, not more than half of the above amount may be generated.

Hydro-Electric Power Plants in the District

There are a large number of power plants within the boundaries of the District system. Some have been idle since

the system took over the supply of power, and others are in service in municipalities which have not yet joined the Niagara System. A number of the idle plants are available for local use in emergency. A table of the various plants giving the location, capacity and ownership of each is shown on pages 24 and 25 of our Consulting Engineer's report on the Niagara System.

Transmission Lines

Up to October 31st, 1921, the Commission had acquired or constructed 466.2 miles of 110,000-volt steel tower transmission lines, forming a high voltage primary network receiving power from the step-up transformer station at Niagara Falls and feeding fifteen step-down transformer stations which are listed on pages 26 to 29 of our Consulting Engineer's report. Four of these stations step the voltage down to 26,400 volts. The remainder transform to 13,200 volts, to supply the various municipal and other corporations and consumers, comprising the Niagara System, through 91 distributing stations. The secondary distribution lines comprise in all 1,007.4 miles and are constructed on steel and wood supports.

Transforming & Distributing Stations

The main receiving station of the Niagara System is the Niagara Transformer Station at Niagara Falls South, to which power is delivered at 12,000 volts from The Ontario Power

the Niagara River over the supply of power, and where are
in service in municipalities which have not yet joined the
Niagara System. A number of the 1913 plants are available
for local use in emergency. A total of 18 various plants
giving the location, capacity and ownership of each is shown
on pages 24 and 25 of our Technical Supplement's report on
the Niagara system.

Transmission Lines

By an Orders 1141, 1211, the Commission has approved
or constructed 48.5 miles of 110,000-volt steel tower transmission lines, including a high voltage primary distribution transmission
power from the step-down transformer stations at Niagara Falls and
Trading Stamps step-down transformer stations which are listed
on pages 26 to 29 of our Technical Supplement's report. Over
of these stations step the voltage down to 22,000 volts. The
secondary transform to 12,000 volts, to supply the various
municipal and other corporations and consumers, connecting
the Niagara System, through 23 distributing stations. The
secondary distribution lines comprise in all 1,007.4 miles
and are constructed on steel and wood supports.

Transformer & Distributing Stations

The main receiving stations of the Niagara System is the
Niagara Transformer System at Niagara Falls Ontario, in which
power is delivered at 12,000 volts from the generator lines

Company, the Toronto Power Company and the Canadian Niagara Power Company. Part of this power is transformed to 46,000 volts to supply four distributing stations, but the larger part is raised to 110,000 volts to supply the high voltage system with its fifteen step-down transformer stations feeding the 87 distributing stations formerly referred to. A table of transformer and distributing stations on the system, giving the voltage and capacity of each is shown on pages 25, 27, 28, and 29 of our Consulting Engineer's report.

The following table shows the present total capacity of the Niagara System:

Station		Capacity K.V.A.
Total Capacity of Niagara System excluding Reserve	-	426,150
Niagara System Reserve Capacity	-	171,575
Total Capacity Niagara System including Reserve	-	597,725

Local Distributing Systems

With the exception of the rural lines already mentioned, there are no municipalities on the Niagara System in which the Commission distributes power retail to consumers. The Commission acts as wholesale distributor, and in all the municipalities the electricity is distributed by the municipality itself or by the local commissions in the municipalities. The accounting

of the local communities in the municipality.". The remaining the electricity is distributed in the municipality issued on [illegible] electrical energy, and in all the municipalities communities distribute their electric energy to consumers. The consumers are no municipalities on the Alpine Power in which the [illegible] rate as variable electricity, and in all the municipalities

Local Distribution Systems

With the exception of the small local [illegible] municipal [illegible] to 110,000 volts to supply the high voltage system with the Alpine [illegible] transformer stations feeding the 27 distribution substations formerly referred to. A table of transformer and distribution stations on the system, giving the capacity and currently it which is shown on pages 20, 21, 22, and 23 of our Commission's report.

The following table shows the present total capacity of the Alpine stations:

Station	Capacity in K.V.A.
Main Capacity of Alpine System:	
"Holding Station" -	80,000
Alpine Power Centre Capacity -	170,000
Total Capacity Alpine System Including Centre -	250,000

for all of the municipalities of the Niagara System is under the direct control of the Commission, and we understand that it is being done in accordance with the standard accounting system of the Commission.

A map showing location of generating stations, transformer stations and transmission lines forms the frontispiece of this report.

GENERAL ECONOMICS

In this report "General Economics" is divided into two sections - Section #1 dealing with the Niagara System proper, being transmission lines, transforming and distributing stations and rural lines only, and Section #2 dealing with the future operation of the System in its broadest sense, including the Queenston-Chippawa Development, The Ontario Power Company, etc.

SECTION #1

Capital Investment

Under authority of the Power Commission Act and agreements with the Municipal Corporations of Toronto, London, Guelph, Stratford, St.Thomas, Woodstock, Kitchener, Galt, Hespeler, St.Mary's, Preston, Waterloo, New Hamburg and Ingersoll, the Commission constructed transformer stations,

transmission lines and distributing stations for the purpose of furnishing electrical energy to the said municipalities.

The Niagara Rural Lines which consist of primary or main lines were constructed by the Commission in order to provide electrical energy to rural customers adjacent to certain municipalities in the Niagara System and the delivery of power over these lines commenced in the fiscal year ending October 31st, 1913.

Details relative to the investment in the Niagara System proper and Niagara rural lines, by years from 1912 to 1921, inclusive, are as follows:

Table of Progressive Capital Costs

Capital Assets	1912	As at Year ending October 31st 1913	1914	1915	1916
Transmission Lines	$2,798,210	$3,509,526	$5,505,047	$6,370,462	$6,748,650
Transformer & Distributing Stations	1,360,611	1,645,450	2,339,246	2,759,320	3,063,390
Rural Lines	-	35,883	159,382	275,118	324,168
Totals -	$4,158,821	$5,190,859	$8,003,675	$9,384,900	$10,136,208

Economic-plus and administrative problems for the purpose of promoting industrial energy in the rural communities.

The Kingsmen Power Plant which consist of [illegible] air-cooled power stations as the economics of water so involved economical energy to rural consumers primarily in matching in the Kingsmen Lights and the Kingsmen Power were taken into ownership in the first year during Salmon Lake, 1918.

Details relative to the improvements in the Kingsmen Lights Copper and Kingsmen Rural Lines, by years from 1918 to 1924, inclusive, are as follows:

Table of Comparative Capital Costs

Capital Costs	1920	As of Year Ending December 31st 1921	1922	1923	1924
Transmission Lines	$6,797,216	$ 3,397,026	$ 3,016,047	$ 4,270,444	$ 4,715,185
Transformers & Electrical Equipment	1,240,420	3,177,324	3,177,324	3,770,324	3,772,324
Rural Plant	-	54,424	120,047	170,114	270,147
Totals	$8,037,636	$6,574,350	$6,313,418	$8,210,882	$8,757,656

Table of Progressive Capital Costs (cont'd)

Capital Assets	As at Year ending October 31st, 1917	1918	1919	1920	1921
Transmission Lines -	$ 7,702,413	$ 8,009,097	$ 8,042,416	$ 8,197,520	$ 8,790,635
Transformer & Distributing Stations-	4,003,676	5,293,073	5,790,871	8,295,833	8,533,621
Rural Lines -	453,443	481,288	473,085	475,666	476,426
T o t a l s-	$12,159,532	$13,783,458	$14,306,372	$14,969,019	$17,800,682

During the fiscal year ending October 31st, 1922, the Commission made additional expenditures on the Niagara System in the amount of $3,918,169.13, making a total investment in the Niagara System proper at October 31st, 1922, of approximately $21,718,850.76. The expenditures made during the fiscal year ending 1922 comprise the following:

Right-of-Way	$ 159,770.11
Steel Tower Lines	984,562.26
Transformer Stations	2,245,446.80
Wood Pole Lines	165,274.56
Rural Lines	363,115.40
T o t a l	$3,918,169.13

The following table indicates the capital cost per horse-power purchased for each of the years ending October 31st, from 1912 to 1921, inclusive:

	Fiscal Year ending October 31st				
	1912	1913	1914	1915	1916
Transmission Lines	$135.70	$96.60	$106.50	$79.80	$64.10
Transforming and Distributing Stations	66.00	45.30	45.30	34.50	29.10
Rural Lines	-	1.00	3.10	3.40	3.10
T o t a l s -	$201.70	$142.90	$154.90	$117.50	$96.30

	Fiscal Year ending October 31st				
	1917	1918	1919	1920	1921
Transmission Lines	$ 58.30	$ 58.20	$ 54.30	$ 47.40	$ 45.90
Transforming and Distributing Stations	30.30	38.50	39.10	36.40	44.50
Rural Lines	3.40	3.50	3.20	2.80	2.50
T o t a l s -	$ 92.00	$100.20	$96.60	$86.60	$92.90

It will be noted from the above table that the capital cost per horse-power for transmission lines was high in the early years of the system when the load was scattered but declined as the load density increased. The capital cost per horse-power for transformer and distributing stations shows a decrease during the years 1915 to 1918 and in 1920 when the stations were loaded heavily, but in 1921 returned to approximately the pre-war figure.

The engineers of the Commission estimated as at October 31st, 1921, that additional funds would be required during the fiscal year ending October 31st, 1922, in the amount of $3,545,000.00 for extensions and betterments to the Niagara

	Fiscal Year ending October 31st				
	1929	1928	1927	1926	1925
Transmission lines and substations and distributing stations	$123,70	$104,40	$94,40	$77,40	$83,20
Miscellaneous items	36,00	22,20	22,20	26,60	22,20
Total	-	1,00	2,10	4,40	2,10
	$160,70	$127,60	$118,40	$107,40	$108,20

	Fiscal Year ending October 31st				
	1929	1928	1927	1926	1925
Transmission lines and substations and distributing stations	$ 38,80	$ 28,20	$ 26,20	$ 27,20	$ 22,20
Total line-locating expenses	3,40	2,00	2,10	2,60	2,20
Total	-	$ 30,20	$28,30	$29,80	$24,40

It will be noted from the above table, that the original cost per horse-power for transmission lines was high in the early years of the company when the demand was largely for lighting and the load density low. The original cost per horse-power for transformers and distributing stations was considerably higher for years 1926 to 1929 and in 1928 when the stations were loaded heavily, but in 1929 returned to approximately the pre-war figure.

The engineers of the Commission estimated on the October 31st, 1929, that additional funds would be required during the fiscal year ending October 31st, 1930, in the amount of $2,589,000.00 for extensions and betterments to the Niagara

System lines, stations and rural lines.

Reserve for Renewals

The balance in the reserve for renewals at October 31st, 1921, amounted to $2,222,365.90 made up as follows:

	Reserve	Interest at 4 per cent.	Together
Period 1912 to October 31st, 1916	$684,368.90	$42,993.63	$727,362.53
Year ending October 31st, 1917	221,543.00	29,094.60	250,637.60
1918	266,579.32	39,245.52	305,824.84
1919	293,940.60	51,428.28	345,368.88
1920	310,519.12	65,205.39	375,724.51
1921	322,462.26	80,234.41	402,696.67
Together -	$2,099,413.20	$308,201.83	$2,407,615.03
Less - Miscellaneous Deductions (net)			185,249.13
Total at October 31st, 1921 -			$2,222,365.90

The additions to the reserve for renewals on the Niagara System have been provided by including on a sinking fund basis in the cost of power each year an amount equivalent to 2½% on the capital investment of the system exclusive of right-of-way. Interest at 4% is added on the credit balance in the account at the close of the preceding year. Charges against the reserve consist of expenditures on account of renewals, replacements, etc.

Syrian Times, Aleppo Independent (1926).

Debtors (Arabic):

The Religious in the Prayer Air Monopoly of Cotton Jute, 1911, amounts to £1,[illegible] Government of Syrians.

Debtors	Principal as at 1st Jan.	Interest
Period 1870 to December 31st, 1914	£[illegible]	£[illegible]
Year ending December 31st, 1917	[illegible]	[illegible]
1918	[illegible]	[illegible]
1919	[illegible]	[illegible]
1920	[illegible]	[illegible]
1921	[illegible]	[illegible]
1922	[illegible]	[illegible]
Total	£[illegible]	£[illegible]
Less - Miscellaneous Debentures Land		[illegible]
Total at Tabaka Dist, 1921	-	£[illegible]

The Religious of Old Cotton Air Monopoly on his Religious Prayer Land Debtors is indicated on a statement that Saint is far part of Land with Land in Amount equivalent to £[illegible] as the original investment of the Syrian Industries of Aleppo-Jute-Spinner as £[illegible] is based on his usual Outcome in the Market at the price of the Prevailing Year. Therefore assigns the Property Rights of Religious Debtors to Government, Implements, etc.

The method of providing additions to the reserve, known as a sinking fund basis, is equivalent to a renewal rate of approximately 4% per annum on the so-called "straight-line-basis", that is to say, while the amount of the annual provision under the sinking fund method increases each year through interest accumulations and those under the straight line method remain constant, the amounts accumulated by either method would be approximately the same at the end of a given period - in this case twenty-five years.

The annual rate of 2½% for renewals was determined in 1917 on the basis of a re-classification of the properties of the system as at October 31st, 1916, made by the Engineering Department of the Commission. This rate has continued in force to October 31st, 1921, and the reserve as constituted at that date has been computed upon the same basis from the beginning of operations in November, 1911.

In commenting upon the adequacy of the renewal accounts as at October 31st, 1921, our Consulting Engineer reports to us that:

> "It is understood that it is the practice of the Hydro-Electric Power Commission to spend sufficient money on maintenance account each year to keep each and every portion of the System in a condition to operate in accordance with the requirements of economical production, which, it is stated, is about 75 per cent. as good as its original new condition . If this be so, the consideration of the renewals account might well be studied in connection with and applied to the renewal of only 25 per cent. of the depreciable capital concerned.

The method of providing additives to the reactor, known as a cleaning plan Dualy, is equivalent to a reactor that accommodatively fit for access to the co-solid contamination-basis". That is to say, while the amount of the amount injection under is always down during instant just what further inter-ment accumulation not take under the wholesale time making possible contact. The overall disintegrate of fission product would be approximately the same as the one if a prime-period in this case known-like point.

The inner part of the reactor was designed in view of the basis of a co-ordinating of the structure of the system by the Tenant Ian, 1970, over by the Engineering Department of the Chemistry. This was the INSTITUTE in force in Dublin, 1971, the reactor on commission of that data has been analysing with the mine Data and the beginning of operation in January, 1971.

In November from the milestone of the various centers as an Tenant Ian, 1971, our visualizing industry principle of that

"It is understood that it is the purpose of the Dublin-Institute Lower Course Reactor to a good multi-sized tabling in multiplication measure such that it depends the operation of the Institute with the Institute is a certain area and after operation of the Institute. Further, in continuation of measurement systems, which, in addition to operation in Institute with the Institute, is about 75 per cent. as good as the original. It about 75 per cent. as good as the original. Of this in mb, the mission-engineer data minister. Of this in mb, the mission-ministering of the nominal output will be stopped to measurement with and supply at the Institute. Further, in the case of the Institute, the Institute supplied measurement.

"The total invested capital in the Niagara distribution system proper at October 31st, 1922, is on the order of twenty-one or twenty-two millions of dollars of which the depreciable amount is probably between eighteen millions and twenty millions. Considering all the factors, the portion of depreciable capital to be covered by a renewal account might be considered as between five million dollars and six million dollars after making allowance for the portion said to be provided for in the maintenance account as above mentioned. As the Niagara System was commenced twelve or thirteen years ago with a comparatively small capital, and as the invested capital has been steadily increasing year by year, it would appear that the total amount in the reserve account, which now stands at a figure between two and three million dollars, is sufficiently large to serve the required purpose".

We are informed by the Government Auditors of the Commission that the Engineers of the Commission have made a reclassification of the properties constituting the Niagara System proper and have reduced the renewal rate from 2½% to 1¾% per annum with interest added at 4% per annum as was the previous practice, to be effective from October 31st, 1921. It will be noted that this represents a reduction in the annual provision for renewals of approximately 50%.

Reserve for Sinking Fund

Under Section 23, Paragraph (b) of the Power Commission Act, the Commission is required to provide "an annual sum sufficient to form in thirty years, with interest at four per cent. per annum, a Sinking Fund for the repayment of the

advances made by Ontario under this Act for the payment of the cost of the works", and under Paragraph (2) of the same Section "a municipal corporation which has entered into or shall hereafter enter into a contract with the Commission for a supply of power may be relieved by the Commission from payment of any sum on account of the sinking fund account for the first five years, during which payments are made to the Commission by the corporation under such contract, and the amounts required from such corporation on sinking fund account shall be payable during the then next ensuing thirty years".

The basis for ascertaining the amount of the reserve for sinking fund each year is, for the Niagara System Lines and Stations, the capital cost of the transformer stations and transmission lines, etc., completed and in operation. The method used by the Commission in calculating the amount of the reserve is as follows:

The annual sum sufficient to form in thirty years, with interest at four per cent. per annum, the amount of capital invested. This sum is equivalent to an annual rate of 1.8% of the principal invested.

The capital investment of the respective sections of the Lines and Stations is distributed to the municipalities and others receiving power therefrom in the proportion that the horse-power furnished each customer bears to the aggregate horse-power furnished all customers on these sections of the Lines.

The rate of 1.8% is applied to the principal so determined, proper allowance being made for any units of plant in operation less than a year.

The portion of the reserve, determined as outlined in the foregoing, applicable to municipalities in operation for a period of six years or longer, is included each fiscal year in the cost of power furnished the respective municipalities. For such municipalities as may not have been in operation for that period the sum apportioned against the municipality in its first year and deferred, is included in the cost of power in sixth year of operations, etc.

As permitted under the Act, the collection of the sinking fund was deferred for a period of five years in the cases of all municipalities in this system. The balance in the sinking fund reserve at October 31st, 1921, in the amount of $957,717.89 is made up as follows:

Balance at credit of Sinking Fund as at October 31st, 1916			$74,708.45
Amounts included as part of the cost of power in five fiscal years ending October 31,1921:			
To Municipalities	-	$629,781.67	
To Companies	-	178,440.66	808,222.33
Interest at 4% per annum	-		73,158.61
Miscellaneous -			
Credits		2,222.26	
Charges		593.76	1,628.50
Balance as at October 31st, 1921			$957,717.89

Of the total amount of $957,717.89, as shown above, $670,525.56 and $287,192.33 were credited as being applicable to municipalities and to companies respectively.

The above shows the aggregate amount of the sinking fund collectible at October 31st, 1921, from 79 municipalities

which have taken power for six years or longer, the initial charge in each case being made in the sixth year's power cost.

Reserve for Contingencies

The balance in the reserve for contingencies at October 31st, 1921, amounted to $24,875.01. The reserve was established by the Commission for the purpose of providing for special losses or expenses not arising at regular intervals and not wholly applicable to the period in which incurred.

The provision for contingencies in respect of the Niagara System is made up of

(a) An annual charge of $37,500. included as a part of the cost of power delivered to municipalities and to sundry customers.

(b) The net profits resulting from the sale of power to sundry customers.

(c) Profit from sales of miscellaneous material, etc., and

(d) Interest at 4% per annum on the monthly balances.

The following is a summary of the reserve for contingencies to October 31st, 1921:

Amounts included as a part of the cost of power delivered		
To Municipalities -	$151,685.07	
To Sundry Customers -	35,674.25	$187,359.32
Net profit from sale of power to sundry customers-		78,932.96
Net profit on sales of aluminum cable, sundry equipment, etc. -		7,645.80
Miscellaneous material recovered, previously charged to construction, operations, etc. -		22,097.90
Interest at 4% per annum -		9,314.90
Total Credits		$305,350.38
Deduct - Expenditures to cover contingencies met with for year ending		
October 31st, 1918 -	$135,140.70	
1919 -	70,840.96	
1920 -	43,576.64	
1921 -	30,917.57	280,475.87
Balance as at October 31st, 1921 -		$24,875.01

Details relative to the expenditures made and charged against the contingency reserve are shown on Exhibit 6A of Messrs. Price, Waterhouse & Company's report on the Niagara System dated October 9th, 1922.

It will be noted that the balance is much less than the average contingent expenditure for the last four years and our Consulting Engineer has expressed the opinion that consideration should be given to the provision for a larger reserve for contingencies.

Accounts with Municipalities

Accounts with municipalities are divided by the Commission, in the main, as follows:

(a) Power Accounts Receivable

(b) Due by or to municipalities in respect of power furnished them, as determined under the Power Commission Act.

(a) Power Accounts Receivable

The balance of Power Accounts Receivable at October 31st, 1921, amounted to $476,448.68. These accounts represent unpaid balances in respect of interim power bills rendered which are paid currently by the municipalities and were all paid at September 20th, 1922, (the date that they were examined by our Accountants), with the exception of accounts aggregating $4,399.87.

(b) Due by or to Municipalities in Respect of the Cost of Power

At the close of each fiscal year, the interim power bills rendered monthly are adjusted to meet the operating costs of the system as provided by the Power Commission Act.

At October 31st, 1921, as a result of these adjustments, 63 municipalities had credit balances aggregating $207,815.60 representing overpayments, interest allowances, etc., 59 municipalities had debit balances aggregating $190,814.41 representing underpayments, interest charges,

Monday 9th September

Monday 9th September 1918 was taken up by the Commission, in the main, in hearing:

(a) Lower Canadian Dominion.

(b) Day of the municipalities in regard to power functions from, or duplicating the Power Commission act.

(a) Power - Lower Canadian Dominion

The Minister of Power Matthew Dubitsky at Monday, 1918, received to 3:15,45:45. Power Commission requested supply power to Canadian of Lower Canada which was put certainly by the municipalities and were all pulp or Dominion mills, 1918, like this that they were connect by the Lindsay , that the supplying is recommend supplying 50,000.HP.

(b) Day of the Municipalities in Regard to the Power of Power

At the Hills of West Point Pulp, Mr Lindsay Power Mills Company Ltd. closed in that the Power Commission made of the system as provided by the Power Commission act.

At Sydney Mills, 1911, on a month of three Mills-mills, by municipalities had could be issued supplying pulp,mills.and Dominion commission, increase electricity, etc. of municipalities for Lower Canada -supplying pulp,mills.and Dominion commission. Lower Canada.

etc., and one municipality had no balance.

Of the $190,814.41 owing to the Commission, $146,042.11 had been paid prior to September 20th, 1922, (the date that these accounts were examined by our Accountants), leaving $44,772.30 still owing at that date, consisting of the following:

Bolton	$2,611.64
Brigden	1,257.65
Burford	2,189.42
Comber	2,055.02
Delaware	72.82
Dereham Twp.	1,412.05
Dublin	535.64
Dunnville	7,736.26
[illegible]	1,997.53
Fergus	1,107.75
Goderich	8,511.99
Harriston	572.44
Kitchener	5,338.77
Niagara Falls	775.45
Oil Springs	303.23
Plattsville	873.01
Princeton	907.22
Rockford	1,150.20
Springfield	54.28
Thorndale	1,356.50
Welland	2,381.46
Wyoming	1,572.97
T o t a l -	$44,772.30

Section 23a of the Power Commission Act provides that:

"The Commission may from time to time during the first three years after any municipality shall first begin to take power from the Commission extend the time for payment of sums payable by any municipality".

Some of the balances noted above have been accumulated during periods extending beyond the three-year limit as permitted by the above section of the Power Commission Act,

year, and was multiplied four or five times.

In the year 1840-41 alone in the Cheshire area, 144,000,000 had been paid value in coupons, bills, and from that time these accounts were examined by our accountant, leaving $46,772.00 still owing at that date, consisting of the following:

Bulkeley	$4,000.00
Ellison	7,324.42
Jackson	2,180.42
Swaney	4,568.42
Delaney	22.42
Jackson Tyler	1,023.42
Dublin	623.44
Tarrytown	7,223.42
Jones	2,417.42
Kelly	2,147.42
Bancroft	6,421.42
Durrieux	372.44
Stevens	8,221.42
Simpson Twins	372.42
Oil Company	2,000.42
Flintwaller	372.42
Insurance	127.42
Dunlavy	1,220.42
Everything	22.42
Thomson	2,000.42
Ellison	2,001.42
Spooner	3,412.42
Total	$46,772.42

Feeling the of the power transmission by providing that the Dunlavy may give time to line during the first three years after our association with Tyler Bailey Power from the commission of water the time for payment of more payment to may monopolize.

Some of the Delaware water ever-dry but then accumulated during periods extending beyond the dam-plus limit as well as the water rights belonging to the Tyler Dunlavy Power Company, and was multiplying that of the.

and for that reason certain of the municipalities are in default in the payment of their power bills.

Results of Operation

Power is supplied to the municipalities on the Niagara System on a cost basis as outlined in the Power Commission Act. The cost of such power includes:

1. Operating and maintenance expenses.
2. Interest on moneys invested in the works of the System.
3. Provision for the renewal of the works.
4. Sinking fund on a thirty-year basis to repay the investment in the works of the System.

The operating account of the system for the four years ending October 31st, 1921, is as follows (cents omitted):

Particulars	Year ending October 31st, 1918	1919	1920	1921
Revenue				
From Municipalities	$2,247,495	$2,535,979	$3,180,161	$3,542,029
" Companies	483,547	534,131	570,905	750,466
Total Revenue -	$2,731,042	$3,070,110	$3,751,066	$4,292,495
Operating Expenses & Fixed Charges				
Power purchased	$1,385,706	$1,517,458	$1,966,305	$2,411,965
Operating & Maintenance Expenses	285,224	346,632	333,682	359,416
Overhead Expenses	101,594	159,282	251,416	296,663
Interest	481,613	583,734	644,859	668,319
Provisions for Renewals	266,580	293,941	310,519	322,462
Provisions for Sinking Fund	138,482	151,246	195,570	212,238
Provisions for Contingencies	37,500	37,500	37,500	37,500
Total Operating Expenses & Fixed Charges	$2,696,899	$3,089,793	$3,739,851	$4,308,563

Profit or Loss transferred to Reserve for Contingencies	$34,143	$19,683	$11,215	$ 16,068

	Year Ending October 31st, 1916	1919	1920	1921
Horse-power Billed	156,828.8	165,836.3	177,419.4	201,520.9
Cost per H.P. Billed	$17.25	$19.85	$21.03	$21.32

The profits or losses shown above for the four years ending October 31st, 1921, resulting in a net profit of $9,605.00, arose in connection with the contracts for supplying power to private companies; the municipalities having paid the actual cost of all power furnished to them. As regards power sold to private companies prior to October 31st, 1917, Mr. G. F. Clarkson states as follows in his 1917 audit report:

> "To 31st October, 1917, a net profit of $178,842.31 was earned by the system from power sold to corporations other than municipal ones. Of this amount, the profit of $117,369.21 for the period ending October 31st, 1916, was applied in reduction of the maintenance cost to be met by municipal corporations under contract with the Commission and the profit, $61,473.10 for the fiscal year ending October 31st, 1917, was applied to the Contingency Reserve".

The names of the more important companies and others to whom power was sold under contract during the four years ending October 31st, 1921, and the amount of revenue therefrom and the average rate per horse-power are as follows:

Increase or decrease during the twelve months	[illegible]	[illegible]	[illegible]	[illegible]

	1918	1919	1920	1921
Horse-power utilized	[illegible]	[illegible]	[illegible]	[illegible]
Per cent. utilized	[illegible]	[illegible]	[illegible]	[illegible]

The profits of Canada during the last four years ending December 31st, 1921, resulting in a net profit of $7,[illegible], were in accordance with the expansion of industry to private enterprise. The manufacturing plants the "Canadian" and IX power functioned to them. An engage point also is which simplicity price in Dominion Star, 1919, Mr. G. C. Jackson stated as follows in his 1921 annual report:

> "In Star Window, 1919, a net profit of $[illegible],81 was earned by the Ayrton Crane Power Co. in manufacturing other long-lasting items. In this column, the profit of $[illegible],32 for the power making department first, 1919, was slightly in excess of the manufacture cost to do not by producing manufacture market industry with the Canadian and the profit [illegible],75 for the Crane Power Working Company Star. 1919, was equally in the industrial Industry".

The manner of the Ayrton Industrial Employees and Manufacturing Power Co. and water workers during the Star Power Working Company Star, 1919, and the amount of expense therefrom and the average rate per horse-power are as follows:

Company	Fiscal Year Ending October 31st							
	1918		1919		1920		1921	
	Amount	per H.P.	Amount	per H.P.	Amount	per H.P.	Amount	per H.P.
Baldwin's Ltd-	-	-	-	-	$28,908	$18.64	$54,652	$16.50
Canadian Salt Co.Limited -	$54,958	$35.24	$70,404	$35.85	85,784	37.49	70,824	39.68
Galt,Preston & Hespeler Ry	22,155	24.29	21,922	23.27	23,828	26.37	24,267	25.00
Lake Erie & Northern Rly:								
-Brant -	16,180	19.95	16,984	21.36	19,000	23.06	17,649	23.30
-Simcoe -	10,450	20.00	11,066	18.06	11,842	20.35	12,530	19.95
St.Mary's Cement Co.Ltd	41,646	31.00	51,771	31.00	58,475	31.00	65,905	31.00
Shale Brick Co., Ltd -	-	-	6,907	25.13	19,464	25.00	18,643	25.29
Union Carbide Company	267,481	14.00	221,508	14.00	119,132	7.45	207,536	12.86
Essex System	-	-	14,451	32.84	29,895	30.76	34,878	32.01
Niagara Power Development:								
-Chippawa -	-	-	-	-	3,141	11.78	6,248	16.72
-Montrose -	-	-	-	-	20,733	11.78	71,698	12.52
-Whirlpool -	15,000	9.98	66,184	11.05	91,557	12.23	101,810	13.61
Sundry Companies	55,677	-	52,954	-	59,146	-	63,829	-
T o t a l -	$483,547	-	$534,131	-	$570,905	-	$750,466	-

The Niagara Power Development and the Essex System were charged for power on a cost basis.

The variation in the cost of power sold to the Union Carbide Company in 1920 and 1921 is attributable to a special arrangement made by the Commission with the company to the effect that they would not take power during peak load periods.

The following table shows the sources of power purchased by the Niagara System during the four years ending October 31st, 1921 (cents omitted):

Year ending October 31st	Ontario Power Company Amount	Per H.P.	Canadian Niagara Power Co. Amount	Per H.P.	Sundry Items Amount	Total Amount
1918	$821,806	$9.00	$539,643	$12.00	$12,233	$1,385,706
	12,024	12.00				
1919	851,875	9.00	598,597	12.00	25,047	1,517,458
	41,939	12.00				
1920	870,482	9.00	584,683	12.00	137,866	1,966,304
	242,336	12.00	130,937	18.00		
1921	873,295	9.00	597,231	12.00	193,314	
	140,250	12.75				2,411,965
	607,875	18.00				

Details relative to the amounts appearing under "Sundry Items" in the above table will be found on pages 13 and 14 of Messrs. Price, Waterhouse & Company's report to us on the Niagara System dated October 9th, 1922.

The average cost per horse-power purchased for each of the years from 1918 to 1921, inclusive, is as follows:

	1918	1919	1920	1921
Cost of power as above	$1,385,706	$1,517,458	$1,966,304	$2,411,965
Horse-power purchased	137,642.6	148,030.6	172,912.8	191,572.9
Cost per horse-power	$10.07	$10.25	$11.36	$12.55

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The following table showing the detailed costs per horse-power billed, illustrates in what respects and to what extents the operating costs and fixed charges have varied during the years from 1913 to 1921, inclusive:

	Fiscal Years ending October 31st,								
	1913	1914	1915	1916	1917	1918	1919	1920	1921
Power Purchased	$8.79	9.18	9.09	9.12	9.20	8.84	9.74	11.06	11.92
Operation	1.13	1.04	.76	.85	.74	.74	1.06	1.07	.96
Maintenance	1.12	1.89	1.41	1.65	1.71	1.08	1.17	.81	.82
Overhead	.69	.64	.61	.41	.42	.70	1.03	1.40	1.47
Interest	4.85	4.04	4.13	3.39	3.04	3.07	3.75	3.63	3.31
Renewals }						1.70	1.89	1.75	1.60
Sinking Fund }	3.60	2.81	3.03	3.21	3.42	.88	.97	1.10	1.05
Contingencies }						.24	.24	.21	.19
	$20.18	19.60	19.03	18.63	18.53	17.25	19.85	21.03	21.32

The following indicates the yearly horse-power loads taken by each of the municipalities on the Niagara System. It is of interest to note that the municipalities, with a few exceptions, have taken an increased amount of power each year. The growth of the load for each municipality may be seen by a comparison of the minimum and maximum yearly loads, the minimum yearly load being in the early years of the system, and the maximum load for the most part being in the fiscal year ending October 31st, 1921, as will be observed from a comparison of the yearly maximum load and the 1921 actual horse-power load.

Municipality	Date Power was First Taken	Yearly Minimum Load H.P.	Yearly Maximum Load H.P.	Average Yearly Load to Oct. 31, 1921 - H.P.	1921 Actual Load H.P.
Acton	Jan. 1913	64.4	203.7	136.1	203.7
Ailsa Craig	Jan. 1916	17.9	127.9	89.7	127.9
Aylmer	March 1918	139.6	180.1	158.2	180.1
Ayr	Jan. 1915	35.9	75.3	49.0	75.3
Baden	May 1918	53.9	187.4	152.4	187.4
Beachville	Aug. 1912	84.7	261.9	185.2	261.9
Blenheim	Nov. 1915	73.9	145.8	109.3	145.8
Bolton	Feb. 1915	77.3	121.0	96.7	121.0
Bothwell	Sept. 1915	27.2	141.2	82.1	141.2
Brampton	Nov. 1911	430.4	911.7	676.6	908.3
Brantford	Feb. 1914	1,209.9	4,330.0	2,677.9	4,330.0
Brigden	Jan. 1918	71.5	81.4	77.1	78.5
Burford	June 1915	30.9	43.1	35.8	43.1
Burgessville	Nov. 1916	22.2	26.7	23.5	26.7
Caledonia	Oct. 1912	21.7	86.7	48.0	86.7
Chatham	Feb. 1915	489.2	2,220.0	1,320.1	2,220.0
Chippawa	Sept. 1913	41.5	67.7	55.1	67.7
Clinton	March 1914	98.5	171.7	128.1	167.0
Comber	May 1915	19.5	107.6	45.8	107.6
Dashwood	Sept. 1917	46.5	48.5	47.2	48.5
Delaware	March 1915	7.4	12.4	8.9	12.4
Dereham	Sept. 1919	56.7	81.9	69.3	81.9
Dorchester	Dec. 1914	15.1	26.9	19.7	26.9
Drayton	March 1918	45.9	52.0	49.6	51.1
Dresden	April 1915	62.5	211.9	128.2	192.2
Drumbo	Dec. 1914	14.2	23.6	17.7	23.6
Dublin	Oct. 1917	24.7	27.8	26.4	27.8
Dundas	Jan. 1911	491.5	2,094.4	1,077.8	1,172.0
Dunnville	June 1918	194.3	251.1	227.4	251.1
Dutton	Sept. 1915	41.6	107.2	73.7	107.2
Elmira	Nov. 1913	84.7	296.7	159.2	296.7
Elora	Nov. 1914	57.4	197.5	153.3	197.5
Embro	Jan. 1915	20.3	46.7	31.9	46.7
Etobicoke	Aug. 1917	134.4	352.5	241.9	352.5
Exeter	June 1916	95.7	178.4	142.9	178.4
Fergus	Nov. 1914	97.1	185.1	128.6	185.1
Forest	March 1917	98.3	119.6	107.8	119.6
Galt	May 1911	767.5	2,673.7	1,925.9	2,673.7
Georgetown	Sept. 1913	104.6	539.2	339.9	539.2
Glencoe	Aug. 1920	70.9	70.9	70.9	70.9
Goderich	Feb. 1914	207.3	450.2	320.3	450.2

Municipality	Date Power was First Taken	Yearly Minimum Dead H.P.	Yearly Maximum Load H.P.	Average Yearly Load to Oct. 31, 1921 - H.P.	1921 Actual Load H.P.
Granton	July 1916	12.0	46.0	35.1	46.0
Guelph	Dec. 1910	1,436.4	3,860.9	2,495.8	3,860.9
Hagersville	Sept. 1913	90.6	349.5	153.6	349.5
Hamilton	Feb. 1911	2,763.0	17,415.5	10,287.2	16,995.7
Harriston	July 1916	66.2	233.5	138.1	212.4
Hensall	Jan. 1917	44.2	83.8	59.3	54.1
Hespeler	Feb. 1911	207.6	434.4	321.1	368.5
Highgate	Dec. 1916	45.5	52.8	49.2	45.5
Ingersoll	May 1911	433.6	1,057.0	751.5	981.9
Kitchener	Jan. 1911	1,357.2	6,291.6	3,648.8	6,291.6
Lambeth	April 1915	12.4	27.7	18.3	27.7
Listowel	June 1916	147.5	476.4	319.3	476.4
London	Jan. 1911	3,076.1	12,365.2	7,649.6	12,365.2
Lucan	Feb. 1915	51.2	194.3	123.6	194.3
Lynden	Nov. 1915	73.8	100.8	87.0	100.8
Markham	April 1920	23.2	53.2	53.2	53.2
Milton	April 1913	319.8	720.7	408.5	658.2
Milverton	June 1916	100.9	284.3	232.3	277.0
Mimico	May 1912	55.9	400.0	185.7	400.0
Mitchell	Sept. 1911	114.9	187.6	158.4	187.6
Moorefield	March 1918	26.5	28.0	27.4	27.9
Mount Brydges	March 1915	23.2	28.8	25.8	27.0
New Hamburg	March 1911	90.6	226.2	160.7	226.2
New Toronto	Feb. 1914	35.3	3,852.2	1,764.2	2,924.3
Niagara Falls	Dec. 1915	2,114.7	3,457.5	2,734.0	3,457.5
Niagara-on-the-Lake	Aug. 1919	165.8	182.2	174.0	182.2
Norwich	May 1912	88.9	253.9	163.5	253.9
Oil Springs	Feb. 1918	94.0	119.3	108.8	119.3
Otterville	Feb. 1916	12.5	37.0	25.6	37.0
Palmerston	July 1916	84.4	190.2	117.5	190.2
Paris	Feb. 1914	323.8	671.7	491.2	671.7
Parkhill	May 1920	54.2	54.2	54.2	54.2
Petrolia	May 1916	250.2	589.2	409.6	589.2
Plattsville	Dec. 1914	28.1	79.5	46.9	28.1
Port Credit	Aug. 1912	37.9	114.7	63.9	114.7
Port Stanley	April 1912	63.7	195.7	115.6	195.7
Preston	Jan. 1911	704.4	1,552.6	1,069.3	1,552.6
Princeton	Jan. 1915	10.3	16.1	12.0	16.1
Ridgetown	Dec. 1915	87.8	191.9	138.1	191.9
Rockwood	Sept. 1913	15.5	55.2	35.8	55.2
Rodney	Feb. 1917	24.8	61.8	46.6	61.8

Municipality	Date Power was First Taken		Yearly Minimum Load H.P.	Yearly Maximum Load H.P.	Average Yearly Load to Oct. 31, 1921 - H.P.	1921 Actual Load H.P.
St. George	Sept.	1915	54.1	76.0	53.9	73.9
St. Jacobs	Sept.	1917	60.0	74.9	68.6	74.9
St.Mary's	May	1911	296.8	910.4	448.7	910.4
St.Thomas	April	1912	1,039.9	2,373.7	1,798.7	2,349.9
Sarnia	Dec.	1916	1,084.2	2,861.5	2,142.0	2,861.5
Scarborough	Nov.	1920	169.2	169.2	169.2	169.2
Seaforth	Nov.	1911	194.9	571.5	323.9	385.4
Simcoe	April	1915	100.6	233.4	152.5	233.4
Springfield	Aug.	1917	24.4	36.6	29.0	36.6
Stamford Twp.	Nov.	1916	354.2	438.6	388.7	438.6
Stratford	Jan.	1911	697.7	2,215.1	1,343.8	2,216.1
Strathroy	Dec.	1914	164.9	394.7	278.3	394.7
Tavistock	Nov.	1916	225.7	270.3	253.4	270.3
Thamesford	Feb.	1914	22.8	93.3	55.1	93.3
Thamesville	Oct.	1915	37.2	74.4	49.0	74.4
Thorndale	March	1916	18.0	72.2	39.7	51.3
Tilbury	April	1915	57.8	148.0	84.0	148.0
Tillsonburg	Aug.	1911	191.0	706.1	374.1	410.5
Toronto	June	1911	16,065.0	58,136.3	40,458.1	58,136.3
Toronto Twp.	Aug.	1913	86.0	246.6	138.3	246.6
Walkerville	Nov.	1914	1,253.9	3,472.8	2,626.0	3,472.8
Wallaceburg	Feb.	1915	230.1	806.6	531.3	734.2
Waterdown	Nov.	1911	36.3	123.7	77.4	123.7
Waterford	April	1915	47.4	132.0	103.3	123.8
Waterloo	Dec.	1910	427.3	1,296.0	813.2	1,296.0
Watford	Sept.	1917	47.0	71.1	56.2	71.1
Welland	Sept.	1917	1,736.0	3,257.5	2,659.7	1,736.0
Wellesley	Nov.	1916	113.4	123.6	118.4	119.4
Weston	Aug.	1911	152.8	983.3	519.8	907.0
West Lorne	Jan.	1917	25.7	152.4	72.0	152.4
Windsor	Oct.	1914	1,312.7	4,957.5	2,495.3	4,957.5
Woodbridge	Dec.	1914	70.9	168.1	116.5	168.1
Woodstock	Jan.	1911	808.7	1,713.1	1,166.9	1,713.1
Wyoming	Nov.	1916	25.3	42.2	32.9	42.2
Zurich	Sept.	1917	49.0	61.0	55.8	58.0

The following table shows the actual cost per horse-power for power taken by each of the municipalities on the Niagara System during the period of full years' operations to October 31st, 1921. It is to be noted that the 1921 actual costs per horse-power exceeded the average costs in the majority of the municipalities.

Municipality	Yearly Minimum Actual Cost per H.P.	Yearly Maximum Actual Cost per H.P.	Yearly Average Actual Cost per H.P.	1921 Actual Cost per H.P.
Acton	$26.55	$40.74	$31.43	$34.87
Ailsa Craig	36.18	110.87	43.93	45.88
Aylmer	34.69	44.82	44.65	44.59
Ayr	41.91	53.05	45.80	43.50
Baden	25.15	37.06	29.20	31.63
Beachville	22.04	32.84	27.39	32.84
Blenheim	43.58	59.55	48.85	49.00
Bolton	42.63	56.25	49.40	50.02
Bothwell	48.73	105.02	59.85	49.85
Brampton	18.60	25.31	21.61	23.84
Brantford	15.59	21.30	18.73	20.62
Brigden	52.15	62.30	58.65	62.30
Burford	58.08	76.76	63.90	76.76
Burgessville	41.12	48.68	45.32	47.13
Caledonia	20.43	24.89	23.14	24.59
Chatham	24.15	40.95	26.81	26.24
Chippawa	16.49	20.74	19.10	20.74
Clinton	36.86	46.50	41.91	42.69
Comber	48.70	118.58	64.85	50.31
Dashwood	50.05	64.54	54.76	64.54
Delaware	47.00	83.11	62.91	68.77
Dereham	34.33	37.90	36.44	37.90
Dorchester	35.81	47.17	41.38	47.17
Drayton	64.00	66.74	65.74	66.60
Dresden	30.09	57.93	34.93	33.81
Drumbo	35.32	66.19	47.20	46.11
Dublin	47.09	78.81	60.35	78.81
Dundas	13.27	17.79	14.98	17.79
Dunnville	41.21	46.76	42.97	41.21

The fitted Beta score for Oxford (see the Beta-Binomial fit paper above) be more at the individuals of the Bingham clades during the period of data years, considering to Cheshire, 1320. It is in an average was the year median among the Bonn-Gamma assessed the average score in this moiety of the municipalities.

Municipality	Median Score	Bingham Clades	Average Score	Lost Years
	2.1%	0.0%	3.2%	2.7%
Ulster	41.22	44.74	53.63	100.07
Lilac River	26.10	124.87	42.41	43.00
Lydney	74.39	36.22	44.21	44.49
Age	41.13	28.00	43.67	13.30
Delay	12.12	37.84	19.06	31.22
Dementia	23.06	20.82	27.63	27.24
Diabetic	84.34	83.80	12.12	13.50
Dose	24.52	43.23	49.49	10.00
Difficult	32.39	124.83	23.42	24.03
Dawson	14.34	25.45	23.21	23.24
Jewish	13.08	13.16	23.27	32.13
Ethics	22.13	22.30	28.49	21.30
Infant	27.27	39.32	22.43	22.14
Hospitalization	21.22	23.23	23.32	27.13
Hospital	32.12	22.22	22.11	21.32
Hydrogen	34.14	42.33	28.23	28.28
Ethics	32.42	22.74	23.13	22.32
Ethnic	36.22	42.20	24.17	24.21
Essay	34.77	113.22	23.22	20.13
Economic	22.32	34.24	22.72	24.24
Economics	47.22	22.12	22.13	22.22
Economy	32.23	27.30	24.24	27.21
Environmental	32.21	27.17	23.72	27.17
Encyclopedia	31.22	44.74	21.74	22.23
Encyclopedia	22.22	47.23	23.72	23.23
Encounter	32.22	44.12	27.12	22.11
Endeavor	47.02	72.02	23.22	22.22
Endeavor	13.32	17.27	23.27	27.72
Endeavoring	41.42	45.72	21.27	42.72

Municipality	Yearly Minimum Actual Cost per H.P.	Yearly Maximum Actual Cost per H.P.	Yearly Average Actual Cost per H.P.	1921 Actual Cost per H.P.
Dutton	$34.77	$55.17	$40.32	$39.81
Elmira	29.89	41.69	34.95	32.93
Elora	30.55	44.20	35.61	40.00
Embro	59.97	107.94	74.09	69.60
Etobicoke	19.75	22.89	21.76	22.89
Exeter	36.40	58.39	42.79	47.36
Fergus	33.67	40.04	37.72	40.04
Forest	53.55	58.05	55.39	56.92
Galt	17.62	23.50	20.64	23.50
Georgetown	29.79	60.36	34.98	39.66
Glencoe	71.53	71.53	71.53	71.53
Goderich	41.90	55.53	48.56	49.87
Granton	40.96	96.01	50.40	48.60
Guelph	17.77	21.08	19.35	21.08
Hagersville	30.92	35.68	33.05	31.97
Hamilton	13.36	17.51	15.32	17.51
Harrin ton	40.23	71.02	47.80	40.23
Hensall	47.70	62.19	53.55	52.19
Hespeler	17.50	26.24	21.53	26.24
Highgate	49.05	52.59	50.59	49.11
Ingersoll	20.36	27.72	23.39	25.66
Kitchener	18.25	21.51	20.01	21.51
Lambeth	53.86	67.10	61.00	67.10
Listowel	32.54	41.67	34.64	32.54
London	17.65	22.26	19.95	21.02
Lucan	25.94	59.15	32.90	33.71
Lyndon	39.53	44.06	41.39	43.53
Markham	54.11	54.11	54.11	54.11
Milton	24.38	30.77	26.53	27.72
Milverton	28.50	38.89	31.48	31.20
Mimico	20.51	32.09	22.87	23.32
Mitchell	29.04	37.61	33.41	32.86
Moorefield	64.80	70.85	67.40	66.41
Mount Brydges	49.73	69.62	58.99	69.62
New Hamburg	29.42	40.60	32.64	33.75
New Toronto	20.18	26.15	22.78	26.15
Niagara Falls	9.51	14.23	11.67	14.23
Niagara-on-the Lake	18.68	25.35	21.86	18.68
Norwich	28.47	42.03	33.16	34.70
Oil Springs	37.45	44.49	40.75	40.94
Otterville	41.26	47.40	43.75	43.52
Palmerston	36.49	51.71	41.28	36.49
Paris	16.18	22.21	19.55	20.67
Parkhill	67.25	67.25	67.25	67.25

Availability	Sound of Solution Black Jaw Ice	Invalid Shadows Sensitive Sound Dive	Provide Advertise Method Jaw Ice	Take Letter Dive Pay
Battery	870.77	948.37	645.11	870.25
Thick	37.87	21.28	84.19	22.43
Clean	40.23	46.03	32.21	41.10
Copper	12.97	147.84	94.97	58.80
Strategies	43.72	12.02	11.74	12.81
Depth	38.40	48.33	63.47	-27.25
Forgive	22.47	40.14	37.72	47.24
Forest	27.12	52.89	32.15	84.94
Day	17.44	23.10	23.24	15.20
Electrons	29.77	35.31	84.49	27.98
Stone	73.32	73.82	71.02	73.20
Debris	13.74	22.28	44.03	44.47
Tax	25.14	25.28	27.44	25.80
Begin	17.77	23.19	13.00	23.48
Biography	39.73	36.39	32.22	31.47
Dentist	13.28	17.41	13.38	17.23
Sure	20.23	73.03	37.23	23.13
Peanut	77.94	23.17	39.00	27.12
Surprise	37.27	18.45	22.32	39.10
Highway	47.49	22.38	23.24	18.23
Journal	22.31	37.78	20.97	77.48
Hydrogen	18.16	23.23	28.84	21.21
Laughing	20.02	27.13	22.03	27.19
Lifetime	32.25	43.47	32.94	32.06
Locker	17.42	22.24	17.23	23.79
Lesson	41.32	22.18	25.28	29.74
Lunch	34.23	44.88	23.23	-22.20
Daughter	24.13	24.12	29.12	24.12
Cities	31.30	20.77	32.23	17.77
Illness	19.20	28.88	21.44	21.10
Chemist	22.81	29.19	24.87	21.47
Weather	27.74	37.21	20.20	20.64
Electricity	22.20	72.22	27.20	23.22
Major Bridge	23.78	23.23	27.77	22.42
Bad Dangerous	27.43	23.23	34.84	22.72
Sun Provide	18.17	24.12	22.78	24.12
Plastic Child	7.32	27.27	13.27	14.23
Engineer-to-you				
Lake	13.22	25.32	24.24	14.22
Travels	27.47	23.23	32.13	25.71
Old Bridge	37.42	43.49	20.77	27.74
Privatize	42.32	47.20	42.74	22.27
Dangerous	36.45	33.71	21.22	28.32
Drive	13.72	22.13	17.88	20.47
Publish	27.83	27.23	27.22	27.38

Municipality	Yearly Minimum Actual Cost per H.P.	Yearly Maximum Actual Cost per H.P.	Yearly Average Actual Cost per H.P.	1921 Actual Cost per H.P.
Petrolia	$30.77	$42.58	$32.71	$30.77
Plattsville	50.78	105.72	65.95	66.77
Port Credit	20.12	32.72	24.24	27.93
Port Stanley	40.91	58.56	46.14	41.48
Preston	16.51	22.49	19.59	22.49
Princeton	77.21	119.45	94.61	95.11
Ridgetown	39.83	52.13	42.05	41.04
Rockwood	40.44	78.64	48.83	53.33
Rodney	41.93	60.40	47.28	41.93
St. George	31.76	49.57	39.22	39.99
St. Jacobs	29.87	34.87	31.77	34.87
St. Mary's	24.85	31.50	29.15	30.32
St. Thomas	21.66	28.88	24.63	25.89
Sarnia	30.34	35.64	31.81	30.34
Scarborough	37.79	37.79	37.79	37.79
Seaforth	30.31	48.93	37.29	48.93
Simcoe	21.74	36.87	26.61	30.40
Springfield	50.40	65.49	26.69	54.63
Stamford Twp.	11.20	16.19	14.42	15.43
Stratford	22.30	28.46	25.62	26.52
Strathroy	29.93	40.14	34.75	35.58
Tavistock	28.64	33.11	31.57	33.00
Thamesford	38.74	65.58	47.78	49.54
Thamesville	44.53	64.06	52.13	49.01
Thorndale	43.29	96.26	58.57	77.87
Tilbury	37.67	60.06	46.02	40.12
Tillsonburg	27.03	40.16	31.64	34.94
Toronto	12.40	18.36	15.28	18.36
Toronto Twp.	19.79	26.81	24.28	26.81
Walkerville	30.72	44.17	34.12	31.75
Wallaceburg	30.12	53.22	34.07	33.18
Waterdown	25.04	32.95	29.62	31.47
Waterford	28.61	37.80	29.93	34.41
Waterloo	18.65	21.85	20.28	21.67
Watford	77.89	90.98	84.13	77.89
Welland	13.53	17.07	15.05	17.07
Wellesley	32.01	39.03	35.60	39.03
Weston	21.29	41.29	24.76	24.95
West Lorne	35.77	48.95	38.47	35.77
Windsor	29.75	44.17	33.00	29.75
Woodbridge	29.52	33.55	31.47	32.74
Woodstock	17.75	22.88	20.38	22.88
Wyoming	49.60	61.58	53.32	50.04
Zurich	55.60	70.06	59.79	70.06

A report prepared by Messrs. Price, Waterhouse & Company is submitted herewith showing a comparison of the actual estimates submitted to the municipalities with the actual loads and costs for each of the years from the inception of the system to October 31st, 1921.

NIAGARA RURAL LINES

Capital Investment

The investment in the Niagara Rural Lines at October 31st, 1921, comprised the following:

Primary and main lines owned by the Commission but operated and maintained by municipalities owning secondary or service lines tributary thereto -	$434,482.
Rural lines operated by the Commission -	27,068.
Lines under construction -	14,876.
T o t a l -	$476,426.

Reserve for Renewals

Additions to the reserve for renewals in respect of rural lines operated by the Commission at its own risk are provided by an annual charge of 4% on the capital invested, with interest added thereto in each year at the rate of 4% on the balance in the account at the close of the preceding

year. This method of provision, which is equivalent to a renewal rate of approximately 5¾% per annum, on the so-called "Straight Line Basis", would replace the amount of capital investment being reserved for in about 18 years.

No provision for renewals in respect of rural lines constructed at the cost of the Commission and operated by municipalities has been made in the accounts of the Commission, since, under the terms of their agreements, such municipalities are required to set aside a renewal fund at the rate of 5% per annum on all capital expenditures by the Commission on lines of primary voltage. The funds thus set aside are retained by them for renewal of properties of the Commission which they operate.

A summary of the reserve for renewals of the Niagara Rural Lines is as follows:

Period	Annual Provision of 4%	Interest at 4%	Together
1912 to October 31st, 1916	$2,669.74	$ 53.17	$2,722.91
Year ending October 31,1917	1,198.35	108.92	1,307.27
Year ending October 31,1918	787.71	139.30	927.01
Year ending October 31,1919	835.44	159.14	994.58
Year ending October 31,1920	811.76	198.92	1,010.68
Year ending October 31,1921	896.59	239.34	1,135.93
Total Credits -	$7,199.59	$898.79	$8,098.38
Deduct -			
Portion of reserve applicable to equipment transferred from system		$978.77	
Cost of renewing and replacing equipment	$679.70		
Interest applicable to above charges	83.54	763.24	$1,742.01
Balance as at October 31st, 1921 -			$6,356.37

Reserve for Sinking Fund

The Commission is required under the Power Commission Act to provide "an annual sum sufficient to form in thirty years, with interest at four per cent. per annum, a sinking fund for the repayment of the advances made by Ontario under this Act for the payment of the cost of the works".

The balance in the account of the reserve for sinking fund at the close of each fiscal year is as follows:

Period	Annual Provision of $1	Interest at 4%	Compound
Year ending June 30, 1919	$[illegible]	$[illegible]	$[illegible]
Year ending June 30, 1920	[illegible]	[illegible]	[illegible]
Year ending June 30, 1921	[illegible]	[illegible]	[illegible]
Year ending June 30, 1922	[illegible]	[illegible]	[illegible]
Year ending June 30, 1923	[illegible]	[illegible]	[illegible]
Year ending June 30, 1924	[illegible]	[illegible]	[illegible]
Total Yearly	$[illegible]	[illegible]	[illegible]

Balance -

Savings of previous equivalents to replacement expense Carried from column		[illegible]
Part of expenditure for plating elements		[illegible]
Balance available as Alert Storage	[illegible]	[illegible]
Balance as at January 31st, 1924 -		$[illegible]

Reserve for Sinking Fund

The foundation is resulting during the [illegible] to provide "an annual sum sufficient to cover in full at [illegible] with interest at four per cent, per annum, a sinking fund for the replacement of the reservoir made by [illegible] for the payment of the costs of the works".

The balance in the account of the reserve for sinking fund at the close of each fiscal year is as follows:

Period	Balance
October 31, 1917	$19,847.66
October 31, 1918	28,067.39
October 31, 1919	36,456.61
October 31, 1920	46,809.11
October 31, 1921	50,607.68

Of the total sinking fund of $50,607.68 at October 31st, 1921 $48,577.16 is in respect of lines which will eventually become the property of the townships in which they are operated, and $2,030.52 is in respect of eight lines operated by the Commission at its own risk. No portion of the sinking fund for Niagara Rural Lines stood deferred at October 31st, 1921.

Operating Accounts

A list of the municipalities and others served by the Niagara Rural Lines is included as Exhibit VIII of Messrs. Price, Waterhouse & Company's report on the Niagara System, dated October 9th, 1922.

A summary of the operating account of the Niagara Rural Lines for the four years ending October 31st, 1921, is as follows:

Particulars	Year ending October 31st, 1918	1919	1920	1921
Municipalities operating at risk of Commission -				
Revenue	$3,542	$3,915	$4,522	$5,328
Expenses				
Operating cost including power purchased	$1,953	$2,227	$3,029	$3,191
Fixed Charges	1,939	1,998	1,968	2,318
Total Expenses -	$3,892	$4,225	$4,997	$5,509
Balance - Loss	$350	$310	$475	$181
Municipalities not operating at risk of Commission -				
Revenue	$103,605	$83,443	$90,770	$93,124
Expenses				
Operating cost including power purchased	$73,509	$51,709	$59,238	$64,012
Fixed Charges	30,096	31,734	31,532	29,112
Total Expenses -	$103,605	$83,443	$90,770	$93,124
Balance -	-	-	-	-

Of the municipalities operating and maintaining the lines held under trusteeship by the Commission, sufficient charges were made against them to cover sinking fund and interest, and also the cost of power in the case of five of them, which were

Particulars	Year ending December 31st, 1952	1953	1954	1955
Installations under construction as at December 31st -				
Assets	22,342	14,232	14,232	22,232
Expenses				
Operating cost including fuel, heavy water production and steam charge	17,294	14,227	24,221	24,221
	1,340	1,882	2,222	2,222
Total expenses -	24,834	24,242	24,227	24,222
Balance -	[illegible]	[illegible]	[illegible]	[illegible]
Installations in operation as at 31st December -				
Assets	320,000	320,000	320,000	320,000
Expenses				
Operating cost including the power production steam charge	172,000	121,222	122,222	222,222
	32,342	21,222	21,222	22,222
Total Expenses -	320,000	222,222	222,222	222,222
Balance -	-	-	-	-

If the installations operating and maintaining the atom with water transmitted to the combination, electricity charge were made against them in order finally that the industry, not also the cost of power in the case of atom, which were

charged direct with the cost of power furnished. Those not charged direct by the Commission with the cost of power receive power from and make payment therefor to municipalities to which they are adjacent. The lines operated by the Commission at its own risk showed a deficit each year for the four years ending October 31st, 1921, although from the commencement to October 31st, 1921, the operation of these lines resulted in a surplus of $1,590.47.

As at October 31st, 1921, of the thirty-three municipalities and townships operating lines on their own account, twenty-nine had neither debit nor credit balances, and four had credit balances aggregating $1,022.31, representing accounts payable to them by the Commission. Of the eight lines operated at the risk of the Commission, seven lines showed a surplus of $2,323.96, and one line a deficit of $733.49, or a net surplus from operations of $1,590.47, mentioned above, which latter amount represents a surplus account in the balance sheet of the Commission.

SECTION 42

FUTURE OPERATION

The acquisition and construction by the Commission of three large development plants at Niagara Falls within the past six years, involving an investment in excess of $100,000,000, renders the question of the future operation of the Niagara System in combination with these development plants a matter not only of unusual interest but of great importance.

It has been noted that the works and equipment designated in the reports and records of the Commission as the "Niagara System" consist only of transformer stations and transmission and distribution lines and other accessories delivering power from Niagara Falls and do not include these development plants. Neither do the figures and data given in "General Economics", Section 41, of this report include these development plants but relate only to the operation of the Niagara System as it has been in the past, for the period ending 31st October, 1921. The Niagara System in the future, however, will include these three big plants, namely, The Ontario Power Company, the Queenston-Chippawa Development and the Electrical Development Company, and will also include one small generating plant at Erindale on the Credit River, a steam-driven reserve power plant in the City of Toronto, a potential supply of purchased power from the Canadian Niagara Power Company at Niagara Falls,

and the transmission and distribution lines of the Niagara System proper. There are, in addition, distribution systems known as the Essex and Thorold Systems, which will probably lose their identity and become part and parcel of the Niagara System in the very near future. For the sake of convenience the Niagara System proper is hereafter referred to simply as the "Niagara System", and the Niagara System, as including all works developing and delivering power from Niagara Falls and its vicinity, other than the so-called Essex and Thorold Systems, is referred to as the "Greater Niagara System".

During the year 1922 the Queenston-Chippawa Power Development began to deliver power, and in the same year the Commission took over the Toronto Power Company including the plant of the Electrical Development Company of Niagara Falls, so that the operating figures and costs up to 1921 furnish, in themselves, but slight assistance in computing figures and costs for 1922 and subsequent years. No report on the Niagara System would be complete without an examination of such new and important factors. Instructions were accordingly given to our Consulting Engineer to prepare a supplementary report dealing with the engineering economics of the system in respect of the future operations of the generating plants now at Niagara Falls and its vicinity in combination with the old Niagara System. This report which is entitled "Engineering Data, Economics of H. E. P. C. Distribution Systems, Study of

Niagara System, Part II, Being for Period Commencing November 1st, 1921" is submitted to Your Honour herewith.

In addition to this report of our Consulting Engineer we have obtained from our Accountants, Messrs. Price, Waterhouse & Company, a report dated October 9, 1922, on "Investigation of Accounts of Niagara System" and a further report dated January 24, 1923, upon "Changes in Investment in Capital Assets and Estimated Results from Operations for the Ten Months Ending August 31, 1922", both of which reports we now submit to Your Honour. Parts of these reports are incorporated herewith. The recently issued report of the Commission for the fiscal year ending October 31, 1922, furnishes additional information as to results of operations to that date which was not available at the time our Accountants' and Engineer's reports were prepared.

Power Load

In dealing with the combined operation of the plants in the Niagara district, our Consulting Engineer traces the growth in the power loads required by the system. His figures show that there has never been a surplus of power and that the growth has been generally regular and rapid. In summing up the conclusions arrived at, he states:

> "As a result of these investigations, it would appear that on the whole a growth of about 10% per annum may be expected in the Niagara District during the next decade or so..... If this indication be confirmed, it will not be very long

before the whole of the generating plants now completed or under construction on the Canadian side at Niagara Falls will be loaded to full capacity, and further sources of power supply must then be obtained if the industrial growth of the Province is to be maintained. It would, therefore, seem prudent to undertake studies of all feasible projects in the Niagara peninsula for still further increasing the available power supply and to have plans outlined for further developments before the time when the capacity of the Queenston-Chippawa plant will have been reached, probably within a comparatively few years."

Included as page 12 of our Consulting Engineer's report referred to is a curve showing "Peak Loads in Electrical Horse-power" on all the systems of the Commission, from the year 1911 to the year 1922. This chart shows that the Greater Niagara system represents a power load of about 550,000 horse-power out of a grand total for all systems of about 640,000 horse-power. In other words, the municipalities and private customers receiving power from Niagara Falls and its vicinity consume about 86 per cent. of the total power supplied by the Commission throughout the whole Province of Ontario.

Combined Operations of Development Plants

In discussing the combined operation of all plants in the Niagara District, our Consulting Engineer says that:

"Many factors enter into the problem of utilizing the existing plants and future plants to best advantage.... It would appear that the most efficient use of the four older plants on the Canadian side (the Canadian Niagara, The Ontario Power Company,

> the Electrical Development and the International Railway Company) would probably be at an output of about 350,000 horse-power requiring approximately 27,000 cubic feet of water per second; that the present normal use of these four plants at about 400,000 horse-power requires approximately 33,000 cubic feet per second and that the peak capacity of the four plants would give an output of about 450,000 horse-power, requiring about 37,000 cubic feet per second. The figures for peak capacity are in excess of what could be obtained continuously and they represent really the peak capacity of the four plants individually."

Mr. Francis next deals with the Queenston-Chippawa Power Development. While The Ontario Power Company has an average operating head of 100 feet, the Canadian Niagara an average operating head of 120 feet and the Electrical Development Company an average operating head of 130 feet, the Queenston-Chippawa Development has an average operating head of about 305 feet; and while a cubic foot of water per second will produce 14 to 15 horse-power at The Ontario Power Company's plant, a cubic foot per second at the Queenston-Chippawa plant will produce 30 to 31 horse-power. If the quantity of water available is limited, it is clear that much greater results will be attained by utilizing it at the Queenston-Chippawa Development than at any of the other plants.

Mr. Francis has prepared for us the following table which shows the possible output of the Queenston-Chippawa Development if amounts of water running from 5,000 cubic feet per second to 20,000 cubic feet per second were available and the necessary plant were also available, and with the plant

operating at an overall efficiency of 90 per cent., which efficiency in the present plant, Mr. Francis states, he has recently demonstrated by tests:

Power Available at Queenston-Chippewa Power Development, 305 feet Head - 90 per cent. Efficiency

Flow Cubic Feet per Second	Electrical H.P. Available	Flow Cubic Feet per Second	Electrical H.P. Available
5,000	157,000	13,000	407,000
6,000	188,000	14,000	438,000
7,000	229,000	15,000	470,000
8,000	250,000	16,000	500,000
9,000	282,000	17,000	532,000
10,000	313,000	18,000	563,000
11,000	344,000	19,000	594,000
12,000	375,000	20,000	625,000

Hereafter are given further tables which Mr. Francis has prepared for us in which he compares the results from the combined operations of the four older plants with the results from the Queenston-Chippewa plant, under the conditions of "Probable Most Efficient Use", "Ordinary Present Use" and "Possible Maximum Use".

1. Condition of "Probable Most Efficient Use"

Total Water Used, Cubic Feet per Second	Four old Plants in Combination: Water Used Cubic Feet per Second	Horse-power	Queenston-Chippewa Plant: Water Used Cubic Feet per Second	Horse-power
36,000	27,000	350,000	9,000 . .	232,000
40,000	27,000	350,000	13,000 . .	407,000
45,000	27,000	350,000	18,000 . .	563,000
50,000	27,000	350,000	23,000 . .	720,000
55,000	27,000	350,000	28,000 . .	875,000

2. Condition of "Ordinary Present Use"

Total Water Used, Cubic Feet per Second	Four old Plants in Combination: Water Used Cubic Feet per Second	Horse-power	Queenston-Chippewa Plant: Water Used Cubic Feet per Second	Horse-power
36,000	33,000	400,000	3,000	94,000
40,000	37,000	400,000	7,000	229,000
45,000	33,000	400,000	12,000	375,000
50,000	33,000	400,000	17,000	532,000
55,000	33,000	400,000	22,000	686,000

3. Condition of "Possible Maximum Use"

Total Water Used, Cubic Feet per Second	Four old Plants in Combination: Water Used Cubic Feet per Second	Horse-power	Queenston-Chippewa Plant: Water Used Cubic Feet per Second	Horse-power
36,000	37,000	450,000	-	-
40,000	37,000	450,000	3,000	94,000
45,000	37,000	450,000	8,000	250,000
50,000	37,000	450,000	13,000	407,000
55,000	37,000	450,000	18,000	563,000

Our Consulting Engineer then states:

"Summing up the above information, we obtain the following figures as representing the total output for the assumed flows tabulated, when used in the four Canadian plants now existing, in combination with the Queenston-Chippewa plant or an extension thereof:

Total Water Used Cubic Feet per Second	At Probable Most Efficient Use	At Ordinary Present Use	At Possible Maximum Use
36,000	632,000	494,000	438,000
40,000	757,000	629,000	544,000
45,000	913,000	775,000	700,000
50,000	1,070,000	932,000	857,000
55,000	1,225,000	1,088,000	1,013,000

These figures, we would again point out, show not only the quantity of power that may be developed under conditions as they are today, but what quantity might be developed if 55,000 cubic feet per second were available and plants at which it could be used were also available. We shall state in detail the actual capacity of the Queenston-Chippawa Development in our special report on that subject.

The last table indicates the advisability of operating the Queenston-Chippawa plant to its full capacity, leaving the less efficient plants to use the remainder of the available water. The plants of the Canadian Niagara Power Company and the International Railway Company, requiring approximately 9,675 cubic feet per second, not being controlled by the Commission, must of course be considered in operating the Queenston-Chippawa plant to its fullest capacity. To render available the larger quantities mentioned in our Engineer's tables will necessitate an amendment to the existing treaty with the United States.

Capital Investment

The capital investment in the Greater Niagara System as of 31st October, 192[illegible], may be briefly classified as follows. (cents omitted);

1.	Queenston-Chippawa Power Development	$65,642,616
2.	Ontario Power Company Development Plant including Third Pipe Line, transmission lines and subsidiaries	25,405,677

3.	Toronto Power Company, including development plant of Electrical Development Company and transmission lines of subsidiaries	$21,267,531
4.	Transmission Lines and Transformer stations of the Niagara System	21,718,851
	Total	$134,034,675

The particulars of the expenditure upon the Queenston-Chippawa Power Development will be set out in our report upon that development. A complete analysis of the investment of The Ontario Power Company is given in our report entitled, "Report on The Ontario Power Company of Niagara Falls." The preceding section of this report, "General Economics", Section #1, gives in detail the particulars of the capital investment in the transmission lines and transformer stations of the Niagara System.

The nature of the liability of the Commission and the Province in respect of the capital investment in the Greater Niagara System may be conveniently summarized as follows, (cents omitted):

1.	Cash advances by the Province in respect of the Queenston-Chippawa Power Development, the Third Pipe Line of The Ontario Power Company, and the transmission lines of the Niagara System	$85,312,073
2.	Guarantees by the Province in respect of the payment of outstanding bonded indebtedness of acquired properties, and Bank loan	36,093,832

3. Toronto Power Company, increasing development plant of electrical development Company and transmitting power to Niagara	$40,000,000
4. Transmission lines and transformer stations at the Niagara system	18,720,000
Total	$58,000,000

The particulars of the expenditure upon the generation-distribution power development will be set out in our report upon that development. A complete analysis of the investment of the Ontario Power Company is given in our report entitled, "Report on the Ontario Power Company at Niagara Falls." The presentation of this report, "Financial Feasibility", dealing it, gives in detail the particulars of the capital investment in the transmission lines and transformer stations at the Niagara system.

The matter of the liability of the Commission and the Province in respect of the capital expenditure in the Ontario Niagara System may be conveniently summarized as follows.

Issue outstanding:

1. Cash advances by the Province in respect of the Queenston-Chippawa Power Development, the Thirty Mile Line of the Ontario Power Company, and the transmission lines of the Niagara System	$18,318,000
2. Guarantees by the Province in respect of the payment of outstanding bonded indebtedness of capital properties, and term loan	38,000,000

3. Guarantees by the Commission in respect of bonds of the Toronto Power Company-not guaranteed by the Province	$ 8,264,700
4. Balance, representing withdrawals from General Fund of Commission in excess of cash advances by the Province	4,364,070
Total	$134,034,675

The amount of capital invested in all of the power undertakings of the Commission throughout the Province, including the Central Ontario System, amounts to approximately $163,[illegible]; therefore, the investment in works for developing and transmitting power from Niagara Falls represents about 80 per cent. of the total investment in all the power undertakings of the Commission in Ontario. If the investment of the Province in the Central Ontario System be omitted, the proportion of the expenditure on the Greater Niagara System reaches over 89 per cent. of the entire capital expenditure of the Commission.

An exceptional feature of the Greater Niagara System is that only 63 per cent. of the investment is represented by cash advances by the Province, while in the case of every other system, except Muskoka, Thorold and Essex, the total capital investment is represented by advances made to the Commission by the Province. Of the remaining 37 per cent. of the investment in the Greater Niagara System, 27 per cent. is represented by bonds assumed by the Commission and guaranteed by the Province, while the remainder, amounting to approxi-

mately 10 per cent., represents $8,264,700 bonds of the Toronto Power Company, payment of which was assumed directly by the Commission and not guaranteed by the Province, and $4,364,070 which the Commission took out of its general funds and which is not covered by any Legislative appropriation. This amount will have to come from some source and the Commission will doubtless request the Government to provide it, if it has not already done so.

Sinking Funds

As the Province has directly or indirectly advanced to the Commission for the purposes of the Greater Niagara System over $120,000,000, it is vitally interested in seeing that proper provision is made for the repayment of this large sum, while the municipalities are deeply concerned as to nature and extent of the sinking funds that are established to secure repayment of the advances made by the Province and in the annual contributions to the renewal and other reserves, all of which are immediately reflected in their power bills. Besides, there has been a widespread belief on the part of the municipalities that at the end of a thirty-year or thirty-five-year period they would own the works outright. We have, therefore, directed our attention to the question as to the plans that have been adopted for securing the advances made and liabilities assumed by the Province and what prospect there is of the expectations of the municipalities in regard to future ownership being realized.

The provisions of the Power Commission Act in respect of sinking funds are simple. The Act provides that the Commission shall collect from municipal corporations, as part of the cost of power, an annual sum sufficient to form in thirty years with interest at 4 per cent. a fund which shall be sufficient to repay the advances made by the Province, under the Act, for payment of the cost of the works from which the power supplied to them is developed. The Commission defers the time for initial payments on account of sinking fund, for repayment of advances made from time to time by the Province, for five years, so that the sinking fund may not be complete for at least thirty-five years after the several advances were made. In the case of the Thunder Bay System a forty-year sinking fund period is fixed by special Act. The Commission takes the ground that the Greater Niagara System also is exempt from the provisions of the Power Commission Act respecting sinking funds, and in other respects as well. It claims that the Greater Niagara System comes under the provisions of The Ontario Niagara Development Act, 1917, which fixes no period within which contributions to the sinking fund must be begun or completed. An estimate of future power rates in the Niagara District, which the Engineers of the Commission have submitted to us, makes provision for a sinking fund for the Queenston-Chippawa Development on a 40-year basis with a 5-year deferment period, or 45 years in all. Without enter-

The provisions of the Power Commission Act in regard to minimum rates are simple. The Act provides that the commission shall obtain from municipal corporations, or parts of the province, or company, an annual tax sufficient to pay for hydro-electric power with interest in a year and a half work shall be sufficient to repay the advances made by the Province, under the Act. For payment of the cost of the works from which the power supplied to them is developed, the Commission defers the time for initial payments on account of existing rates, for repayment of advances made from time to time by the Province, for five years, so that the existing rate may not be complete for at least thirty-five years after the initial advances were made. In the case of the Thunder Bay System a forty-year existing rate period is fixed by special act. The Commission takes the ground that the Cromstor Finance System also is exempt from the provisions of the Power Commission Act regarding minimum rates, and it seems to operate as well. It claims that the Cromstor Finance System comes under the provisions of the Ontario Municipal Act, 1921, which fixes a period within which municipalities by the finding that the rate is complete or completed. An estimate of future power rates in the Niagara District, which the Engineers of the Commission have submitted to us, makes provision for a minimum rate for a 40-year period with the interest-charge development on a 40-year basis with a 5-year deferment period, or 45 years in all. Without entering

ing upon a discussion of the legal merits of such an interpretation, the following summary is presented to show the nature of the sinking fund provisions now in force, or proposed, in respect of the capital investment in the Greater Niagara System:

1. Queenston-Chippawa Power Development $65,642,616

   This amount is, or doubtless will be, wholly represented by cash advances from the Province. According to estimates submitted to us by the Commission, of probable cost of generating power from this Development, the Commission proposes to establish a sinking fund on a 40-year basis with 5-year deferment period.

2. Ontario Power Company

   (a) Third Pipe Line 3,514,676

   This amount is represented by cash advances from the Province and loan from the Bank of Montreal and in respect of which sinking fund has been established on a 30-year basis with no deferment period.

   (b) 40-Year 4½ Bonds of the Commission issued in connection with the acquisition of the capital stock of The Ontario Power Company 8,000,000

   Sinking fund established in fiscal year ending 31st October, 1921, on basis sufficient to retire bonds at maturity - approximately a 37-year basis, with a 3-year deferment period. (In this case we find the anomalous position of a company establishing a sinking fund out of its revenue to retire securities issued by its stockholders to pay the purchase price of the shares of the company)

(c) 20-Year 6% Bonds of the Commission issued to retire bonds of The Ontario Power Company which matured in 1921 — $3,200,000

Sinking fund established on basis of annual charge of 1% per annum with interest added annually at 4%. (approximately a 41-year basis, with no deferment period)

(d) First Mortgage 5% Bonds of The Ontario Power Company, maturing in 1943, payment of which was assumed by the Commission and guaranteed by the Province, at the date of acquisition of the shares of the company — 9,092,000

The Trust Deed under which these bonds were issued requires an annual payment to the Trustees, to be applied as sinking fund, equivalent to $1.00 per horse-power generated and sold in the preceding year. Up to the present time the Commission has not included as an operating charge any amount for sinking funds in respect of these bonds and the initial payments to date have been taken, to a large extent, out of renewal funds of the company. Inasmuch as The Ontario Power Company may be said to be subject to the provisions of the Development Acts, the Commission may adopt the same basis as applied to Queenston-Chippawa (1.), namely, a 40-year basis with a 5-year deferment period.

(e) First Mortgage 5% Bonds of the Ontario Transmission Company, maturing in 1944, payment of which was assumed by the Commission and guaranteed by the Province at the date of acquisition of the shares of the company — 1,599,000

The Trust Deed under which these bonds were issued requires an annual payment of $30,000 to the Trustees to be applied by them in the retirement of these securities. Up to the present time the Commission has not included as an operating charge any amount for sinking fund in respect of these bonds, and the annual payments have been taken, to a large extent, out of renewal funds of the company. Inasmuch as the Ontario Transmission

Company may be said to be subject to the provisions of the Ontario Niagara Development Acts, the Commission may adopt the same basis as applied to Queenston-Chippawa, (1.), namely, a 40-year basis with a 5-year deferment period.

3. Toronto Power Company

(a) 20-Year 6% Bonds of the Commission issued in connection with the acquisition of the properties of the Toronto Power Company, maturing 1st December, 1940 — $ 619,000

It is understood that the Commission proposes to establish a sinking fund on a 40-year basis with no deferment period, from 1st December, 1920.

(b) 5% First Mortgage 30-year Gold Bonds of the Niagara Development Company, maturing 1st March, 1932, payment of which was assumed by the Commission, but not guaranteed by the Province, on acquisition of the Company — 4,161,500

The Trust Deed hereunder requires an annual payment to the Trustees of $1.00 per horse-power generated and sold in the preceding year. It is understood, however, that the Commission proposes to establish a sinking fund on a 40-year basis with no deferment period.

(c) 4½% Consolidated Debenture Stock of the Toronto Power Company, maturing 1st May, 1941, payment of which was assumed by the Commission and guaranteed by the Province on acquisition of the Company — 12,383,831

The Trust Deed under which this stock was issued stipulates that the Company shall make an annual payment to the Trustees of £109,001:7s:3d, together with interest on the total amount of the issue. This amount, together with

interest applicable to securities which have been previously purchased, is to be applied in the retirement of securities of this issue. The amount so paid is intended to retire the issue at maturity. The Commission, however, has taken the position that to include these annual payments in power costs would be prohibitive. It is understood that the Commission proposes to establish sinking fund on a 40-year basis with no deferment period, from 1st December, 1930, and in the meantime finance these annual payments either by loans or advances from the Province, or by the use of reserve funds.

(d) 5½ Mortgage Bonds of the Toronto Power Company, maturing 1st July, 1934, payment of which was assumed by the Commission but not guaranteed by the Province, on acquisition of the Company $ 4,103,000

There is no provision in the bond covenant in respect of sinking fund. It is understood, however, that the Commission proposes to establish a sinking fund on a 40-year basis with no deferment period.

4. Transmission Lines and Transformer Stations of the Niagara System 21,716,651

The general provisions of the Power Commission Act have been complied with, i.e., 30-year sinking fund basis with 5-year deferment period

Total $134,034,674

From an examination of this summary it is apparent that only in respect of the expenditure on the transmission lines and transformer stations of the Niagara System and the

expenditure upon the Third Pipe Line of The Ontario Power Company are payments being made on sinking fund account on the 30-year basis contemplated by the Power Commission Act. Thus, out of a total capital investment in the Greater Niagara System of $134,034,674, only $25,233,528, or about 19%, is, or is to be, provided for on a thirty-year basis. This is in striking contrast to the course followed in the other Systems of the Commission throughout Ontario. If the contention that the general provisions of the Power Commission Act in respect of sinking funds do not apply to that part of the Niagara System that comes within the scope of The Ontario Niagara Development Act, 1917, is correct, it means that over seventy per cent. of advances made by the Province to the Commission are exempt from these provisions.

The capital investment in the Queenston-Chippawa Power Development as of October 31st, 1922, was $55,642,616, and the Engineers of the Commission estimate that the final cost, with units installed to the full capacity of the canal, will be $62,485,914. This is exclusive of the investment in works required for the transmission of Queenston-Chippawa power, which has been included in the Niagara System proper and will be repayable on the same basis as the other investment in the "Niagara System Proper". If this estimate should prove to be correct, and no additional expenditures are made in the meantime, the total capital investment in the Greater Niagara System on the completion of the Queenston-Chippawa Development will be over $151,000,000. If the intention of

expenditure upon the Niagara Falls Power Company are payments being made on minimum fees according to the 30-year basis contemplated by the Power Commission act. Thus, out of a total capital investment in the Ontario Niagara System of $19,[illegible],000, or about 14%, is, or is to be, provided for on a thirty-year basis. This is in striking contrast to the course followed in the other districts of the Commission throughout Ontario. If one consider that the general provisions of the Power Commission act in respect of rights do not apply to that part of the Niagara System that comes within the scope of the Niagara Development Act, 1921, it appears, is more than ever apparent. of advance made by the Province to the Commission for Niagara Work purposes.

The capital investment in the Queenston-Chippawa Power Development as of October 31st, 1923, was $[illegible],[illegible],[illegible], and the Estimates of the Commission provide that an (ex) cost, with main turbines in the full equipment of the canal, will be $[illegible],[illegible],000. This is exclusive of the investment in water rights for the transmission of generator-chippawa power, which has been included in the Niagara System project and will be repayable on the same basis as the other investment in the "Niagara System Project". If this estimate should prove to be correct, and as additional expenditures are made in the meantime, the total capital investment in the Niagara System in the municipalities of the Queenston-Chippawa Development will be over $19,[illegible],000. If the interest of

the Commission in respect of sinking funds, as expressed to us, should be carried out, about 67 per cent. of the total capital investment in this System at October 31, 1922, representing cash advanced by the Province and amounts taken from the general fund of the Commission, will be repaid on a thirty-year or on a forty-year (plus 5-year deferment period) sinking fund basis.

The remaining 33 per cent. of the capital investment in the Greater Niagara System is represented by bonds, all of which, except the First Mortgage Bonds of the Toronto Power Company assumed by the Commission, are guaranteed by the Province. No uniform sinking fund policy appears to have been decided upon in respect of these bonds. In respect of two issues, viz: the $8,000,000 forty-year 4½ bonds of the Commission issued to pay for the stock of The Ontario Power Company and the 4½%, $12,383,831 Consolidated Debenture Stock of the Toronto Power Company, sinking funds are being set up, or are required to be paid, in amounts sufficient to retire the obligations at maturity. With respect to the latter issue, the Commission proposes to repay this sum on a 40-year sinking fund basis, and some means must be found by the Commission to finance the annual payments of approximately $500,000 per year required to be paid to the Trustees of this issue under the bond covenant. With regard to the remaining issues, the following table shows the approximate amount of sinking fund which will be accumulated at maturity

of the bonds and also the amounts that will not be provided for but will have to be refunded:

	Amount Outstanding at October 31st, 1922	Approximate Amount of Sinking Fund Accumulations at maturity of Bonds	Balance not provided for by Sinking Fund
(1) Ontario Power Company 1st Mortgage 5% Bonds maturing in 1948	$ 9,092,000	$ 2,901,547	$ 6,190,453
(2) Ontario Transmission Company 1st Mortgage 5% Bonds maturing in 1945	1,599,000	596,229	1,002,771
(3) Hydro-Electric Power Commission 20-year 6% Bonds of the Commission issued July 1st, 1921, to retire bonds of The Ontario Power Company	3,200,000	952,898	2,247,102
(4) Electrical Development Company 1st Mortgage 5% 30-year Gold Bonds due March 1st, 1933	4,161,500	708,220	3,453,280
Carried Forward	$18,052,500	$5,158,894	$12,893,606

	Amount Outstanding at October 31st, 1922	Approximate Amount of Sinking Fund Accumulations at maturity of Bonds	Balance not provided for by Sinking Fund
Carried Forward	$18,052,500	$5,156,894	$12,895,606
(5) Toronto Power Company 10-year 5% Mortgage Bonds due July 1st, 1924	4,103,200	167,171	3,936,029
(6) Hydro-Electric Power Commission 20-year 6% Bonds of the Commission due December 1st, 1940, issued in connection with the acquisition of the Toronto Power Company properties	619,000	193,542	425,458
	$22,774,700	$5,519,607	$17,255,093

The foregoing table is based on the following assumptions:

(a) Sinking Fund provisions in respect of (1) and (2) started November 1st, 1922; in respect of (3) and (6) at date of issue, and in respect of (4) and (5) on December 1st, 1920, and will be continued.

(b) All calculations have been based on the sinking fund earning 4% per annum.

(c) All calculations have been made on bases outlined on pages 64 to 67.

It will be noted that the foregoing statement shows that of the bonded indebtedness of $22,774,700 made up of various

amounts, maturing at different dates, only $5,513,607, or less than 25% of the total amount of these outstanding bonds, will be provided for by the proposed sinking fund accumulations at maturity. The remainder will have to be refunded or otherwise provided for.

According to the auditor of the Commission's accounts, Mr. Clarkson, the Commission has always contended that the guarantee of bonds issued by the Commission or the guarantees of the payment of bonds assumed by the Commission, by the Province, is not an "advance" within the meaning of the Power Commission Act, and that, accordingly, the Commission is not required to collect payments on account of sinking funds sufficient to retire the obligations at the expiration of the sinking fund period mentioned in the Power Commission Act. If this contention be correct, it would seem important that the Government, before guaranteeing bonds, should see that adequate provision for their ultimate retirement is made, as the Government's liability on bonds guaranteed by it is just as great as it is on bonds issued by it to raise moneys for the purposes of the Commission. If no sinking fund provision be made for the retirement of these bonds, the properties supposed to be acquired by the municipalities will be encumbered to the extent of the bonds unpaid.

The Commission has not always taken the position that the sinking fund in respect of any part of the works of

the System should be established on a forty-year basis. In the estimates of the cost of power which it submitted to the Government prior to the construction of the Queenston-Chippawa undertaking it based its figures on a thirty-year sinking fund period. In its applications to the Government for advances of money for Queenston-Chippawa under Special Warrant it has based its requests on Section 24b of the Power Commission Act. In other words, the Commission appears to have taken the ground that when it wants money for Queenston-Chippawa it comes under the Power Commission Act, but that in the matter of paying back money it comes exclusively under the provisions of The Ontario Niagara Development Act, which fixes no time for repayment.

Our Accountants have prepared a table with respect to the sinking fund accumulations that will have been provided by the Commission to repay the expenditure upon the works of the Greater Niagara System, more complete than the tables heretofore quoted. This table is set out in full on pages 74, 75 and 76 of this report. It demonstrates that, on the assumptions outlined therein, instead of the total capital investment being repaid at the end of a thirty-five-year period, sinking funds of only $96,409,818 will be accumulated within that period and that a balance of $38,973,440 will have to be provided thereafter.

STATEMENT IN RESPECT OF SINKING FUNDS APPLYING TO THE NIAGARA SYSTEM, INCLUDING THE QUEENSTON-CHIPPEWA DEVELOPMENT, THE ONTARIO POWER COMPANY AND THE TORONTO POWER COMPANY

The figures set forth in Column (2) were obtained from the accounts of the Hydro-Electric Power Commission. The figures in Columns (4) to (6) inclusive are calculated on the bases of Column (1).

Particulars	Balance as at October 31, 1922	(1) Sinking Fund Basis	(2) Amount of Sinking Fund accumulated to October 31, 1922, out of Power charges	(3) Annual Provision on basis of Investment at October 31/'22: On 30-year basis using annual provision of 1.83 of capital invested	(4) Annual Provision on basis of Investment at October 31/'22: On basis outlined in Column (1)	(5) Sinking Fund accumulation at end of 35 years on basis of Column (4)	(6) Balance to be provided after expiration of 35-year period
Cash advanced by the Province to the Commission and expended on lines, stations, etc., of the Niagara System	$21,718,850.00	Sinking Fund charges deferred for five years. Sinking Fund to be accumulated out of charges to municipalities for power during next ensuing thirty years, as per Power Commission Act.	$1,302,984.51	$ 390,939.30	$ 390,939.30	$21,718,850.00	none
Amount expended in connection with the construction of the Queenston-Chippewa Power Development	65,642,615.00	Sinking Fund charges under Ontario Niagara Development Act which does not name specific period. However, the Commission used a 40-year basis with a 5-year deferment period in submitting estimates to the Consulting Engineer of the Inquiry Commission, which has been used in this calculation.	none	1,181,567.07	690,757.23	38,741,077.89	$26,901,537.20
Outstanding bonds of The Ontario Power Company and the Ontario Transmission Co. Ltd., cash advanced to the Company by the Commission, and bonds issued by the Commission in connection with the acquisition of the Company:-		Amounts of $772,213 and $150,000 have been paid to the Trustee of the bond issues of The Ontario Power Company and the Ontario Transmission Co.,Ltd, respectively, in accordance with the requirements of the bond covenants. These amounts have been taken, to a large extent, from renewal funds as no provision for sinking fund in respect of these bonds has been included in the operating expenses. Inasmuch as The Ontario Power Company may be said to be subject to the provisions of The Ontario Niagara Development Act, it is assumed that the Commission may adopt the same basis as applied to Chippewa, namely, a 40-year basis with a 5-year deferment period, which has been used in this calculation.					
-First Mortgage 5% Bonds of the Power Company maturing 1945	9,092,000.00		none	163,656.00	95,679.00	5,366,150.97	3,725,849.03
-First Mortgage 5% Bonds of the Transmission Company maturing in 1945	1,599,000.00		none	28,782.00	16,827.00	943,741.28	655,258.72
Forward	$98,052,465.00		$1,302,984.51	$1,764,944.37	$1,194,202.53	$66,769,820.05	$31,282,644.95

Particulars	Balance as at October 31, 1922	(1) Sinking Fund Basis	(2) Amount of Sinking Fund accumulated at October 31, 1922, out of Power Charges	(3) Annual Provision on basis of investment at October 31/'22: On 30-year basis using annual provision of 1.8% of capital invested	(4) Annual Provision on basis of investment at October 31/'22: On basis outlined in Column (1)	(5) Sinking Fund accumulation at end of 35 years on basis of Column (4)	(6) Balance to be provided after expiration of 35-year period
Carried Forward	$98,052,465.00		$1,302,984.51	$1,764,944.37	$1,194,202.53	$66,769,020.05	$31,282,644.95
Cash advanced by the Commission to The Ontario Power Company for the purpose of constructing the Third Pipe Line.	3,514,677.00	Sinking Fund being accumulated on thirty-year basis with no deferment period	241,548.92	62,667.00	62,667.00	(a) 3,514,677.00	none
Forty-year 4½ Debentures maturing August 1, 1957, issued by the Commission in the acquisition of the capital stock of The Ontario Power Co.	8,000,000.00	Sinking Fund charges started in 1921 on basis sufficient to retire debentures at maturity (approximately 37-year basis).	204,000.00	144,000.00	100,000.00	(b) 6,270,147.00	1,729,852.00
Twenty-year 6% debentures maturing July 1, 1941, issued by the Commission to retire bonds of The Ontario Power Company which matured in 1921	3,200,000.00	Sinking Fund charges started July 1, 1921, on basis of an annual charge of 1½ of the issue (approximately 41-year basis).	32,000.00	57,600.00	32,000.00	2,356,871.04	843,128.96
Outstanding bonds of the Toronto Power Company and bonds issued by the Commission in the acquisition of the properties acquired in the so-called "Clean-up Deal":-	[illegible]						
- 5% First Mortgage 30-year gold bonds of the Electrical Development Company secured under trust deed with the National Trust Company, maturing Sep 1, 1941. (Sinking Fund based on bonds outstanding at December 1, 1920, in the amount of $4,335,000).	4,161,500.00	Bond covenant requires an annual payment to the Trustee of $1.00 per horse-power generated and sold in the preceding year. The Accountant of the Commission has used a 40-year basis in preparing the 1922 accounts, which has been employed in this calculation.	(c) 88,910.64	70,030.00	45,517.50	3,352,464.92	982,535.08
Forward	$116,928,642.00		$1,869,444.27	$2,107,241.37	$1,434,387.03	$82,263,980.01	$34,838,161.99

Particulars	Balance as at October 31, 1922	(1) Sinking Fund Basis	(2) Amount of Sinking Fund accumulated to October 31, 1922, out of Power Charges	(3) Annual Provision on basis of Investment at October 31/'22: On 30-year basis using annual provision of 1.8% on capital invested	(4) Annual Provision on basis of Investment at October 31/'22: On basis outlined in Column (1)	(5) Sinking Fund accumulation at end of 35 years on basis of Column (4)	(6) Balance to be provided after expiration of 35-year period
Carried Forward	$116,928,642.00		$1,869,444.27	$2,107,241.37	$1,434,387.03	$82,263,980.01	$34,938,161.99
4½% Consolidated Guaranteed Debenture Stock of the Toronto Power Company now secured by trust deed to the British Empire Trust Co., maturing May 1, 1941. (Sinking Fund based on debentures outstanding at December 1, 1920, in the amount of $13,558,917.00)	12,383,032.00	Bond covenant requires annual payment of £109,001-7-3 to Trustees together with the full amount of interest on the issue. Interest applicable to retired debentures is to be added to sinking fund and applied in the retirement of securities. The Accountant of the Commission has used a 40-year basis in preparing the 1922 accounts, which has been used in this calculation.	(c) 278,093.40	244,060.50	142,368.62	10,485,764.92	3,073,152.08
5%, ten-year Mortgage Bonds of the Toronto Power Company secured by preference stock of the Electrical Development Company under trust deed - maturing July 1, 1924	4,103,200.00	The Accountant of the Commission has used a 40-year basis in preparing the 1922 accounts, which has been used in this calculation.	(c) 84,156.63	73,857.00	43,100.00	3,180,302.86	922,897.14
Twenty-year 6% Debentures of the Commission due December 1, 1940, issued in connection with the acquisition of the Toronto Power Company	619,000.00	A 40-year basis has been used by the Accountant of the Commission in preparing the 1922 accounts of the Toronto Power Company, and it has been used in this calculation.	(c) 12,695.24	11,142.00	6,514.00	479,770.56	139,229.44
TOTAL -	$134,034,674.00		$2,244,389.54	$2,436,300.87	$1,626,449.65	$96,409,818.35	$38,973,440.65

NOTES - (a) Actual accumulation at the end of thirtieth year. (b) Actual accumulation at the end of thirty-second year (three-year deferment taken).
(c) We understand that these amounts have yet to be submitted to the Commission for approval.
(d) The calculations have all been made upon the basis of the sinking fund annuity 4 per cent. per annum.

According to the theoretical computations of our Accountants, the amounts collected annually in respect of sinking fund from municipalities on the Greater Niagara System on the capital investment as at October 31st, 1922, on the forty-year basis, or other bases employed or proposed, as set out in the summary on pages 64, 65, 66 and 67, will amount to $1,626,449; whereas, if the total capital investment were being repaid over the thirty-five-year period, which is the longest period authorized by the Power Commission Act, the annual contribution to sinking funds from the municipalities would amount to $2,436,300. Thus, the Province, instead of being secured by sinking fund accumulations in respect of its advances and indirect liabilities for the System at the end of the thirty-five-year period, will still remain unsecured in respect of direct or indirect liabilities, after the expiration of that period, to an amount in excess of $37,000,000.

If the construction placed upon the provisions of The Ontario Niagara Development Act by the Commission should be correct, four-fifths of the advances made by the Province would be outside the scope of the Power Commission Act and the Province would be in the anomalous position of receiving from the Commission security for advances for the small developments, which come under the Power Commission Act,

According to the conventional mortgaging of our cities today, the revenue collected annually as support of claims from municipalities on the greater mortgage (claims on the capital investment as at October 31st, 1913, of the territorial towns, as shown hereinbefore in paragraph 44 and in the summary in paragraph 48, of this report) is insufficient, however, if the total interest charges have been issued for thirty-five years and which in the interest period mentioned by the other municipalities the debenture interest is fixed at 4%, the revenue collected by placing that mortgage in the amount of $4,000,000. Thus, the revenue collected by this method by placing that mortgage in the amount of $4,000,000 is $160,000. Thus, the revenue collected by this method is $160,000.

If the municipalities grant such the interest on the capital (capital investment) at 5% the municipalities of military tax-rates as one mortgage upon the revenue only be adding the amount of the annual contribution the Territory should be in the economic position of receiving from the municipalities not mortgage the [illegible] debentures, which are of the [illegible] [illegible].

within thirty-five years, while leaving the time for repayment of advances for the largest development entirely in the hands of the Commission. Thus, the Province, while assuming full responsibility for providing the cash, will have placed out of its hands the right to fix the time or times for repayment of a sum which represents almost half of the Provincial debt.

It is interesting to note some of the effects of this construction of The Ontario Niagara Development Act, 1917. We have already pointed out in a report made by us to Your Honour the change made by the Legislature in 1915 whereby the municipal corporations were required, instead of paying interest at a fixed rate of 4 per cent. upon the cost of works, to pay the actual cost of providing the money, as fixed by Order-in-Council. While the rate of interest remained at 4 per cent. it was possible for the Commission to estimate the annual cost of power with comparative certainty, but when the Legislature provided that the rate to be paid should be fixed according to cost of money to the Government, it became impossible for the Commission to estimate accurately the future cost of power. Now, however, if the Commission can fix the times and amounts for payments on account of sinking fund for the Greater Niagara System at its pleasure, it can restore largely the element of certainty in respect of the developments of this system because the higher the rate of interest it pays the longer it may make the term of

providing sinking funds, thus making the actual cost correspond more closely with the estimated cost.

Should the Commission's construction of The Ontario Niagara Development Act, 1917, be upheld, the municipalities of the Greater Niagara System will, on the completion of the Queenston-Chippawa Power Development and the expiration of the deferment periods, repay into the sinking fund $600,000 annually less than they would pay if under the Power Commission Act; or in other words, $600,000 less than they would pay if they contributed to the sinking fund at the same rate as nearly all the municipalities in the other Hydro-Electric systems in the Province.

There has been general complaint at the hearings that we have held that the rates for power charged in all the Hydro-Electric power systems of Ontario, other than the Ottawa System, are much higher than those charged in the Greater Niagara System. It is natural that the rates should be higher. The immense production of power at Niagara, the density of population in the district served, the great industrial power loads taken there and the consequent lessened cost of transmission, make the cost of power less in the Greater Niagara System than in any other part of Ontario, except at Ottawa where exceptionally favorable conditions prevail. So favorable are the conditions in the Greater Niagara System, where a

market awaits the power as soon as it is generated, that there is much to be said in favor of dispensing with the deferment period altogether. There is nothing to be said that can justify the fixing of a longer term for repayment in the Niagara System than in any other part of the Province. Such a course not only discriminates against all other parts of Ontario but it postpones for a long period the repayment of the advances made by the Province and to this extent tends to lower the Provincial credit. In other words, there appears to be no good reason why the natural advantages which the municipalities in the Greater Niagara System enjoy should be added to by discriminatory legislation in their favor.

Much is heard in Ontario nowadays about a "flat rate", but in the Niagara System the pendulum has swung far in the opposite direction, for the extension of the sinking fund period makes cheap power at Niagara cheaper still and thus adds to the handicap of those in less favored portions of the Province who have to pay higher rates.

We have been told time and again at the hearings held by us that the tendency of cheap Niagara power is to draw industries from the smaller centres to the municipalities in the Niagara System. Such a movement, we have frequently been told, is unhealthy and undesirable and should be discouraged.

The extension of the sinking fund period in the

Niagara System also has destroyed two fundamental principles upon which the Hydro-Electric Power Commission was initiated and developed. The principle that "power is supplied at cost on an equal basis to all" has been discarded, and the popular belief that the municipalities will obtain a complete equity in all works serving them within thirty years is now shown to be without foundation.

It may be that the Legislature did not intend to give the Niagara System longer terms of repayment than it has fixed for the other systems throughout the Province, but whether it did or not, the present conditions appear to us to be worthy of consideration by it.

GENERAL RELATIONS.

A description of the general relations existing amongst the municipalities, the Commission and the Province in respect of the Greater Niagara System would be a simple matter if such relations had merely to be interpreted, as in the case of all other systems, in the light of the provisions of the Power Commission Act. As we have already pointed out, however, they cannot be interpreted because The Ontario

Niagara Development Act and The Ontario Niagara Development Act, 1917, (sometimes referred to as the "Development Acts"), embody special legislation of a very important character affecting the general relations in respect of the works at Niagara Falls serving the district comprised in the Niagara System, with power.

The Niagara System proper, i.e., the transmission lines, transformer stations and their accessories, was constructed under the provisions of the Power Commission Act, and its operation would appear to be in no way affected by the so-called Development Acts. The relations existing with regard to these works is the normal relationship contemplated by the Power Commission Act. The capital cost, some $21,718,850 as at October 31st, 1922, was financed by cash advances by the Province to the Commission; the municipalities are paying, or will eventually pay, interest and sinking fund charges on the thirty-year basis required by Section 23, annually; the Province is receiving interest on its advances and the Commission is year by year depositing Provincial securities, representing the annual sinking fund accumulations, with the Treasurer of Ontario.

The Third Pipe Line of The Ontario Power Company is, in a sense, in the same category. The works as at October 31st, 1922, represented a cash investment of $3,514,677. It was financed by cash advances by the Province, and bank loans,

in respect of which a sinking fund on a thirty-year basis with no deferment period, has been established. It would appear that this work is likewise unaffected by the terms of the Development Acts.

But, when consideration is directed towards the general relations existing with respect to the works represented by the properties of the Ontario Power Company, the Toronto Power Company, and their subsidiaries, and the Queenston-Chippawa Power Development, the terms of the so-called Development Acts must be read with the general provisions of the Power Commission Act. The general relations with respect to the works of The Ontario Power Company are discussed in this Commission's report entitled "The Ontario Power Company of Niagara Falls." The relations with respect to the Queenston-Chippawa Development will be described in a separate report. Although the acquisition of the works of the Toronto Power Company is of too recent date to make a full description of the purchase and operation of these works possible, much information on this subject is included in the foregoing sections of this report. The general legal questions involved in the interpretation of the Development Acts will be discussed in a separate report. For the purpose of this report, we need do no more than to refer Your Honour to the figures, dates and comments contained in the preceding pages.

A deputation from the town of Dunnville, a munici-

pality in the Niagara System, appeared beforeus on February 21st last. Their complaint, as stated by Mr. Marshall, Chairman of the Dunnville Hydro-Electric Commission, being:

> "The Hydro System was introduced in Dunnville in 1916 and 1917 to replace a privately-owned system. The price quoted was $27.77 per horse-power. That was understood to be the maximum figure and the price now is $50.00. ... I think we are paying too much for power. $27.77 is what the people understood was to be the price."

This is the old story told to us time after time by representatives of various Hydro municipalities of low estimates, and a high cost as compared with the estimates. The negotiations between the Commission and the representatives of the town of Dunnville were gone into fully before us by representatives of the town and of the Commission. Mr. R. T. Jeffrey, of the staff of the Commission, speaking for the Commission, gave reasons for the increase of costs; but it is clear that the estimates, as originally submitted were too low and dissatisfaction on the part of the municipality followed. It is also clear that the Commission never submitted to the municipality what it regarded as the possible maximum cost. The figures given were not published with the by-law submitted to the electors, but were given at public meetings and in the press. When testifying before us, Mr. Jeffrey was very frank. He said:

> "If we had to furnish the maximum price and stick right with that particular section of the Act, the scheme would never go ahead because in many cases we would have to put the price so high that they would never take it."

It seems clear that the intention of the Legislature in requiring the Commission to state a maximum price when submitting estimates was that the municipalities might know the highest price which they would have to pay under any conditions, and the procedure first contemplated should, of course, have been followed. If this course had been followed in each case, a vast amount of bad feeling and misunderstanding would have been avoided.

The principal cause of the great difference between actual cost and estimated cost in the case of Dunnville was that the cost of constructing a line into Dunnville was nearly double the original estimate. The original estimate was $32,000 and the actual cost was $65,340.21. Mr. Jeffrey states that this increase was due to two causes, firstly: a change in the type of line upon which the original estimate was based, and, secondly: the great increase in material and labor costs during the period of construction. He says, however, that the town of Dunnville was never advised of a change that was made in plans, which in itself largely increased the original estimate submitted. Mr. Jeffrey says:

> "We figured at that time that the change in the line from the pin type to the suspension type would cost approximately $17,000, and that, of course, would increase the cost of power to Dunnville, and I suppose we should have gone to Dunnville and re-submitted the matter and told them that we had to change the type of line and that would increase the cost of power to them."

It would appear, therefore, that Dunnville has just cause for complaint. Under the original estimate the rate was $37.50 per horse-power. It is now $37.26. It was much higher, but the rate has been lowered owing to the reduction in the renewal rate made by the Commission last December, and to which reference has already been made.

S U M M A R Y

In summarizing the operation of the "Niagara System Proper", we desire to point out that the Commission has, with the exceptions noted, apparently followed the provisions of the Power Commission Act. There are a number of cases where municipalities are in default of payment of their power bills, deficits having been incurred by them subsequent to the three-year deferment period permitted by the Act. While the rural lines operated at the risk of the Commission show a surplus during the whole period of operation, in each of the four years of the period ending October 31st, 1921, small losses were incurred. Insofar as the operating economies of the System are concerned, a study of the accounts shows that the Contingency Reserve is much too low and the amount to the credit of this reserve at the end of October, 1921, was considerably lower than the yearly requirements. This reserve should undoubtedly be built up to much greater proportions in order to fully provide a sum to meet such losses. It is also important to note that very substantial reductions have been made in the renewal reserve rate from time to time. In analysing this matter, our Consulting Engineer points out that up to October 31st, 1921, the amount provided appeared to be quite adequate. Since that date, however, the Commission has reduced the rate by 50%, making the revised rate effective as from October 31st,

1921. This reduction in the renewal rate has materially reduced power costs for the fiscal year 1922. If the reduction were justified it would appear proper to make a more substantial provision for the contingency reserve rather than to give the municipalities the total benefit of the reduction, by way of lower power costs.

The following statement indicates that the Contingency Reserve for the Niagara System is totally inadequate.

While the additions made to the reserve for the fiscal year ending October 31st, 1922, amounted to $222,686.60, the charges against the fund were:

"Expenditures to meet Contingencies"	$ 86,119.16
and	
"Net loss for year on power sold to Sundry Power Customers"	156,588.58
Together	$242,707.74,

or over $20,000 in excess of the amounts made available for this reserve during the year. The balance at the credit of the Contingency Reserve fund at October 31st, 1921, was $24,875.01, while at October 31st, 1921, it was $4,853.87, or an amount so small as to be negligible.

Insofar as sinking funds for the retirement of outstanding bonds are concerned, our study of this matter shows that the Commission has adopted no well-defined or consistent policy in this respect. In some cases no retirement fund is being provided, and where such a fund is being provided

the amount accumulated at the maturity of the bonds will not be sufficient to meet the issues outstanding, thus leaving it necessary for refunding loans to be issued as the bonds outstanding become due.

It would seem well for the Legislature to consider whether or not the Commission should be required to deal with such outstanding bond issues in the same way as cash advances, and to provide yearly sinking fund amounts which, at the end of a fixed period, would equal the total amount of the bonds outstanding. Many of the bonds run for comparatively short periods, and the maturity date of others extends, as shown, to periods of thirty or forty years. It is apparent, therefore, that sinking fund in respect of some bond issues will be much less than the amount required when they fall due. In such cases the balance will have to be provided for by additional loans or advances by the Province.

It is difficult to summarize in a satisfactory manner the conditions disclosed by Section #2, "General Economics". Generally it may be stated, however, that two outstanding principles have always been recognized as applying to the power undertakings of the Commission. These are as follows:

(1) That while the cost of power varies for each municipality according to the load taken, the cost of transmission, etc., the basis used for calculating such cost is

the answer accumulated as the validity of the basis will not be sufficient to meet the higher requirements, thus leaving it necessary for refunding issues to be issued as the needs outstanding become due.

It would seem well for the Legislature to consider whether or not the Commission should be required to deal with such outstanding bond issues in the same way as with extensions, and to provide yearly sinking fund accounts within, at the end of a fixed period, would equal the total amount of the original issue. Only if the bonds are for amortizable assets particle, and the maturity date of other securities, to expire in periods of twenty or thirty years. It is apparent, therefore, that sinking fund in respect of some bond issues will be much less than the amount required when they fall due. In such cases the issuer will only be permitted upon application to the Commission.

It is difficult to summarize in a satisfactory manner the conditions discussed in Article IV, "General Economics". Generally it may be stated, however, that two overshadowing principles have always been recognized as applying to the power undertakings of the Commission. These are as follows:

(1) That while the rate of power varies for each municipality according to the load taken, the cost of transmission, etc., the basis used for calculating such cost is

the same for all, thus placing all municipalities on the same footing in this respect.

(2) That the municipalities acquire a complete equity in all works of the Commission in a thirty-year period by payment of yearly sinking fund amounts.

A study shows that these two principles have not been applied to the "Greater Niagara System" and that by reason of special legislation and the right of the Commission to own and operate companies, the municipalities in this system are in a very favored condition as compared with the municipalities in other systems.

DATED AT TORONTO, Dec. 5th

W. D. Gregory, Chairman
[illegible]
Lloyd Harris
J. Allan Ross
R. A. Ross